Engineering News

VOLUME 74 AUGUST 19, 1915 NUMBER 8

Sheepshead Bay Motor Racetrack

The 2-mi. wood-paved speedway now nearing completion on the flatlands between Jamaica Bay and Sheepshead Bay, Brooklyn, N. Y., is designed to be the fastest automobile racetrack in the world. The pavement, 70 ft. wide, is of 2x4-in. timbers on edge, laid longitudinally of the track on concrete, or concrete and steel, ribs or girders. Inside of the track is a 6-in. concrete pavement 15 ft. in width on the straightaways, gradually widening to 30 ft. at the middle of the turns. This, however, is a factor of safety and not a part of the racetrack proper.

The outer edges of the 70-ft. track on the two 180-deg. turns are given a maximum superelevation of 25 ft. 6 in., computed for a speed of 96 mi. per hr. by the common railway formula $C = \frac{dv^2}{gR}$. The width d was taken in five 14-ft. strips, commencing at the inside of the track, and the superelevation computed for speeds of 40, 52½, 65, 77½ and 96 mi. per hr. This gives a cross-section theoretically of a parabolic curve, and in forming the steel ribs by cold-bending a true parabolic cross-section was obtained by rolling each rib to a carefully made wood template.

The length of the track is measured on a line 3 ft. from the inner edge. There are two straightaway stretches of 1790.52 ft. and two turns of 3489.48 ft. each. The turns are divided into circular arcs of 853-ft. radius, 2095.4 ft. long, with spiral connections to the tangents each 697.04 ft. long. On the straightaway sections the elevation of the outer edge is 1 ft. above the inner edge. The rise from the level of the straightaway to the superelevation of the curves is effected by a 3⅓-per cent. grade with 120-ft. vertical curves at each end. The track layout is given in Fig. 2.

FIG. 1. VIEW OF SHEEPSHEAD BAY MOTOR RACETRACK, LOOKING TOWARD GRANDSTAND AND FINISH LINE

Laying Out the Curves

To make a half-mile curve of steel-work fit together without a hitch required some accurate survey work. It was accomplished as follows: A plan of the curved portions of the track was made showing the deflection angles for the 180-ft. chords of the spiral and the 100-ft. chords of the circular arc in both directions from P.C. to P.T. and from P.T. to P.C. of the outside edge of the track. Each outside spiral had four equal 180-ft. chords. With one 60-ft. chord on the 2260-ft. circular arc it was easily possible to establish the outside curve entirely by angular deflections.

A survey party using a blueprint plan in lieu of notes was started at each end of a curve; the two parties worked toward the middle, met and continued on to check up each other's work. They were required to check on the starting points within ½ in. Transits reading to 20 sec. were used. The tapes for the field-work were first compared with those used by the steel

company to lay out the steelwork, and they were found to be the same length. From the hubs thus established the inner edge of the curve was marked by running radial lines to the curve centers, which were established on the ground. The hubs were further checked by measuring the radial distances to the curve centers.

The exact lines of the inner and outer edges of the curved track being thus established, the locating of the ribs or girders was comparatively simple. The spacing of these is 6 ft. 8 in. on the outer line of the curved portion of the track, or three to every 20 ft., and they are, of course, on radial lines. The spacing of the girders on the tangents is 6 ft. 7 in. In the 10,560 ft. of track are 1654 of these girders.

Bringing the Concrete Surfaces to Grade

The concrete girders or walls are 8 in. wide and the foundations in general extend to about 2 ft. below ground level. The concrete was designed to be carried to a maximum height of 6 ft., above which it was estimated that a steel structure would be cheaper. Owing to variations in the ground level some of the concrete girders are higher than 6 ft. on the outer ends. The concrete was mixed 1 : 3 : 5.

The forms were made of old boards and 2x4's in 14-ft. units. The grades of the top of the concrete were established on forms about 40 ft. apart (6 bays), and strings for each 14-ft. width of cross-section were stretched between these to give grade for the tops of intermediate girders. Nailing strips bent to the required parabolic cross-section of the track were then nailed on one side of the inside of the forms and the finished concrete surface was troweled by hand to this template.

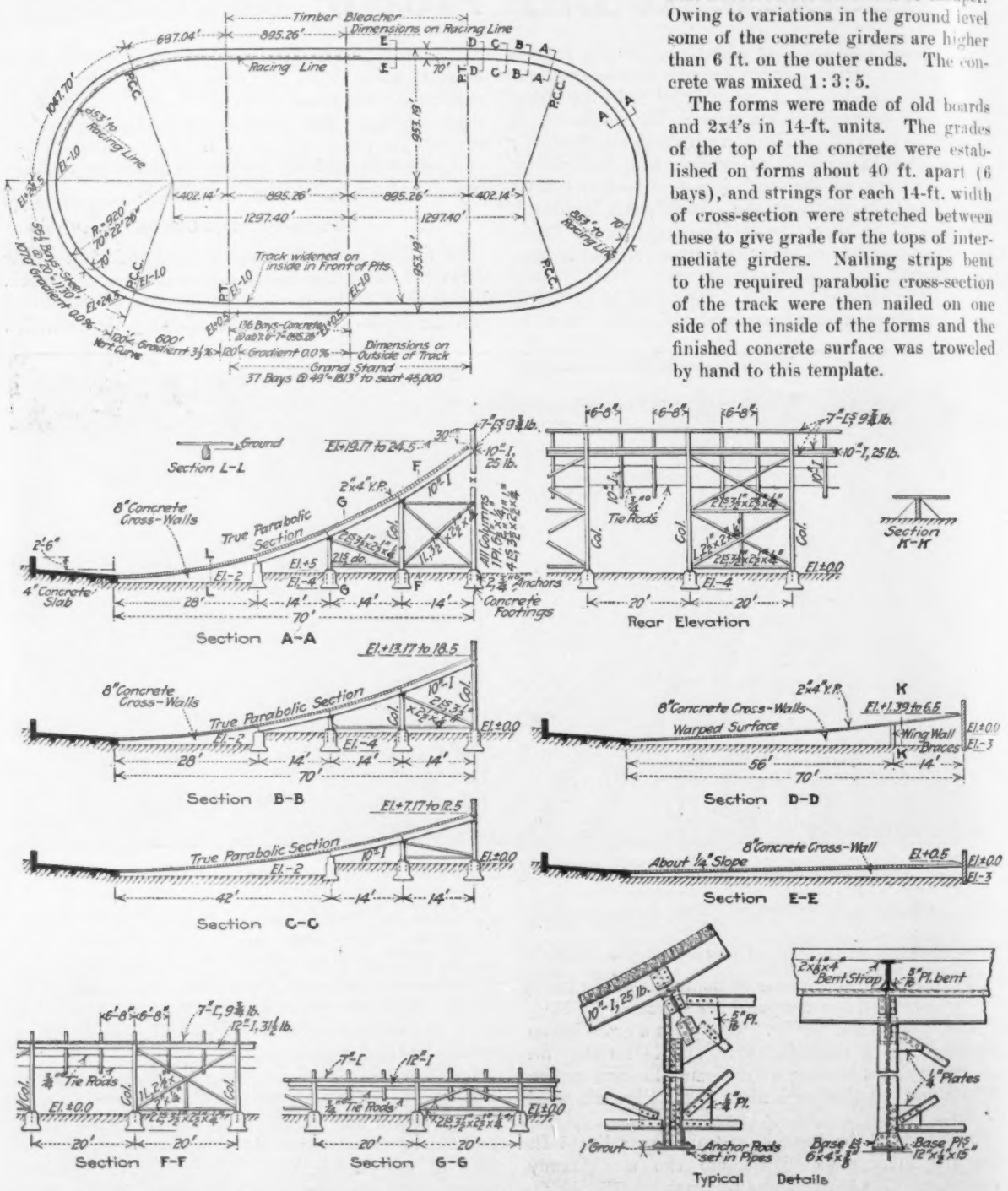
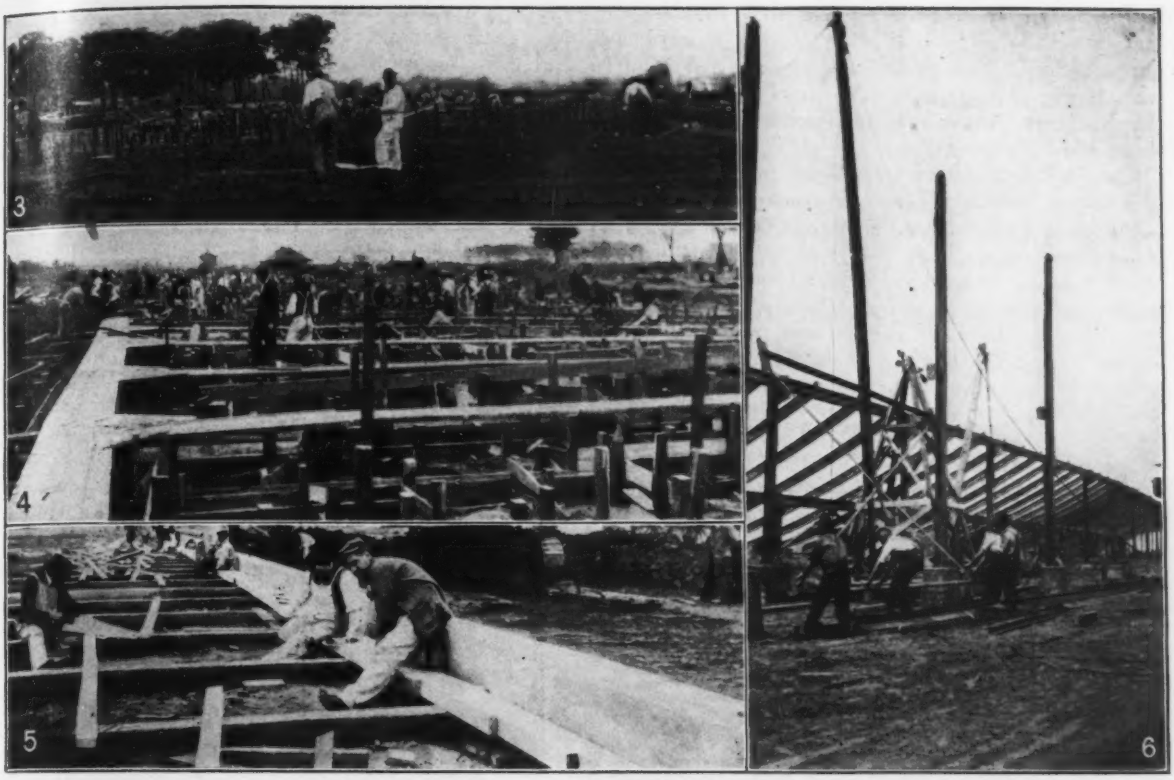


FIG. 2. PLAN AND CROSS-SECTIONS OF SHEEPSHEAD BAY MOTOR RACETRACK, BROOKLYN, N. Y.



FIGS. 3, 4, 5 AND 6. CONSTRUCTION VIEWS OF THE SHEEPSHEAD BAY MOTOR RACETRACK
3—Staking out concrete track supports. 4—Filling concrete forms. 5—Nailing wood flooring. 6—Steel erection

Nearly 1600 tons of steel was used, all of which was erected with a single home-made, horse-operated traveler, shown in Fig. 6. This was designed and built on the job by the foreman of the erection gang, J. R. Ashley. The panels of diagonal bracing came in complete units shop-riveted with ¾-in. rivets. All field connections are bolted with ¾-in. bolts.

The structure is designed to meet the specifications of the New York City building code for a permanent structure. The assumed live-load is of 3000-lb. motor cars on 5x10-ft. wheelbases for the full width of track. An impact allowance of 100 per cent. was made. The steel specifications are the standard of the American Steel Manufacturers Association for manufacture and fabrication.

A view of a part of the completed steelwork is shown in Fig. 7. No difficulties were encountered in erection.

FIG. 7. CONCRETE AND STEEL FLOOR SUPPORTS OR JOISTS

The column pedestals were all accurately located and there was not a single hitch in the erection work. The 2x4-in. floor is fastened to the steelwork by steel angle slips and drift bolts, there being a pair of clips to about each 14-ft. width per panel.

Other Details—Floor, Drainage, Etc.

The 2x4-in. timbers forming the floor are finished on one side and one edge; 16 per cent. were in 14-ft. lengths, 16 per cent. in 16-ft., 18 per cent. in 18-ft. and 50 per cent. in 20-ft. lengths. The intention is to have no single timber which does not rest on at least two supports. The 2x4's are laid so as to have at least 2 ft. lap at adjacent joints and are spiked with 20d. nails about every foot. Traverse expansion and swelling are allowed for by 3-in. open spaces at each edge of the flooring, and about a ⅛-in. space is provided between each timber by leaving the heads of the nails projecting, instead of driving them home. When completed the flooring will be given a paint coat of creosote.

Except where the sandy soil provides sufficient drainage, 8-in. tile drains are laid 2 ft. inside the inner edge of the track. A large number of fire hydrants distributed about the grounds provides ample fire protection.

Entrance to the oval within the track is by means of a concrete-lined subway, the track structure being carried on the concrete walls between passageways. These were built after the practical completion of the track structure.

In front of the grandstand are a series of concrete pits for repairing, oiling and fueling the racing cars. On the opposite side of the track is a subway giving pedestrians access to the timber bleachers from the interior of the oval.

The main grandstand is approximately 1800 ft. long, and is built of structural steel. It has a main deck and a gallery. The timber bleachers are also 1800 ft. long, on the opposite side of the track from the grandstand. These details will be described in subsequent issues of *Engineering News*.

The construction work was started in the spring, and as many as 2000 men have been employed at one time. Little grading was required. On the side near the grandstand there was a cut of 3 or 4 ft. for about 1000 ft., which was done by hand and by small steam shovels. On the farther side was a swamp where a considerable fill was required. Here the column and track foundations are on piles. The track is to be put to use early in October, if the present plans are carried out.

Personnel and Statistics

The track is being built by the Sheepshead Bay Speedway Corporation, of which Everard P. Thompson is manager and vice-president; Blaine H. Miller, formerly chief engineer of the Indianapolis speedway is chief engineer in charge of design and construction, and his principal assistant engineer is H. B. Thorn, in charge of surveys. C. F. Gardner is designing engineer. The general contractor is the Coast & Lakes Contracting Corporation, of New York. The steel is furnished by the Lackawanna Steel Co., and is fabricated and erected by the Lackawanna Bridge Co., of Buffalo, N. Y.

The track structure contains about 3,000,000 ft. b.m. of southern long-leaf yellow pine timber, which cost about $27 per M, and 1570 tons of structural steel at about $57 per ton in place. There are 12,000 cu.yd. of concrete, which cost about $8 per cu.yd.

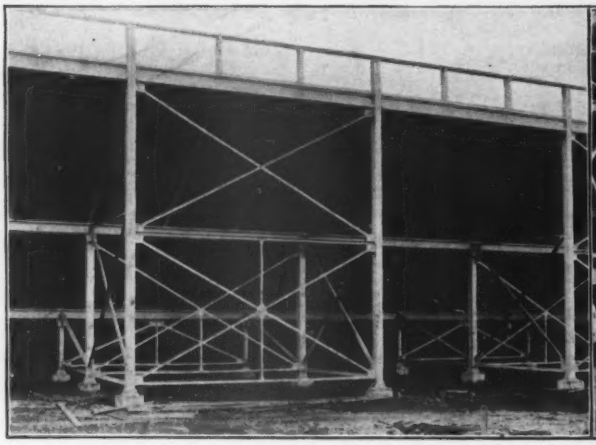


FIG. 8. REAR VIEW OF STEEL FRAME FOR BANKING OF CURVES

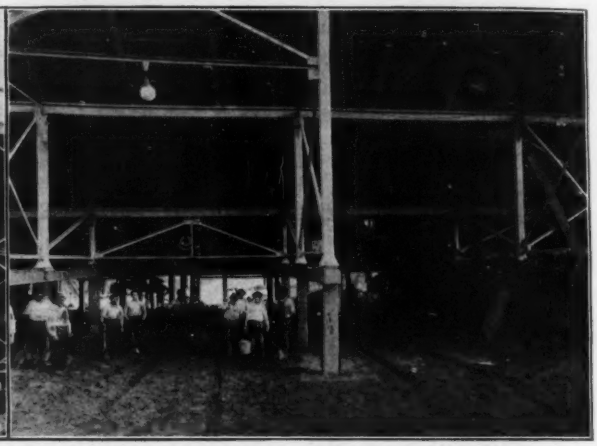


FIG. 9. SUBWAY UNDER TRACK FOR CARS AND PEDESTRIANS, DURING CONSTRUCTION

New Technology Laboratory Plans Announced

In the new buildings of the Massachusetts Institute of Technology, at Cambridge, a space of about 74,000 sq.ft. has been allotted to the civil and mechanical engineering laboratories. These may be divided as follows: Steam, hydraulic, steam-hydraulic machinery, strength of materials, cement and concrete, heat treatment, gas, compressed-air, power measurement and refrigeration. No attempt has been made to keep each section separate from the other sections. While the plans have been made primarily for needs of instruction, there is ample opportunity for research work. The departments of electric engineering, chemistry, mining, physics, and sanitation of course have their own laboratories.

Hydraulic Laboratory

The equipment and arrangement were planned by the mechanical and civil-engineering departments, with the advice of Prof. C. M. Allen, Clemens Herschel, F. P. Stearns, C. T. Main, and Harry Gay. The laboratory occupies the basement and first and second floors of Building No. 7.

In the basement there are about 700 ft. of canals 5 ft. deep. A 5-ft. and a 3-ft. (width) canal leads from a reservoir at one end. The smaller canal is tapped off into two 26-ft. sumps with 16- and 3-in. special filling valves having long conical seats. The canals and sumps are supplied with water from Charles River through a 14-in. cast-iron pipe. The canal discharge is led outside the building and pumped back into the river.

Between the two canals is a 90-ft. weir box leading from a turbine draft chamber and fitted with quieting screens, open and submerged weirs, hook-gage boxes, etc. The draft tube itself, coming down from the first floor, has a 10-ton gridiron valve with adjusting cutoff grid for holding draft-tube water-level at any desired height.

Hydraulic Machinery

The basement also has a motor-driven rotary pump of 1000 gal. per min. capacity supplying a 5x32-ft. pressure tank carrying up to 500 lb. per sq.in. and a similar low-pressure tank good for up to 80 lb. These tanks are for determining the flow from orifices and nozzles.

For supplying water under pressure for the general hydraulic experiments there will be three triplex pumps, two steam-driven centrifugals, a large engine-driven centrifugal, an underwriter's fire pump and two duplexes. All are cross-connected except the large centrifugal pump, so that one or all may be used. This machinery is in the basement.

For the measurement of large quantities of water—up to 8000 gal. per min—there are two 10x10-ft. cali-

brated open tanks, provided with gage verniers, shifting entrance gates and 10- and 15-in. hydraulic valves. Overhanging the calibrated tanks are two long chutes with weir boxes, taking water from nozzles, orifices and small wheels on the floor above. On the first-floor level is a wooden platform over the sumps, on which pulsometers and similar apparatus may be tested with various friction depths.

Rising up through the first floor is a 12-ft. steel cylinder used as a penstock for a turbine placed 8 ft. above this level and discharging into the large basement weir box. There are here also three impulse wheels discharging into the basement weir boxes.

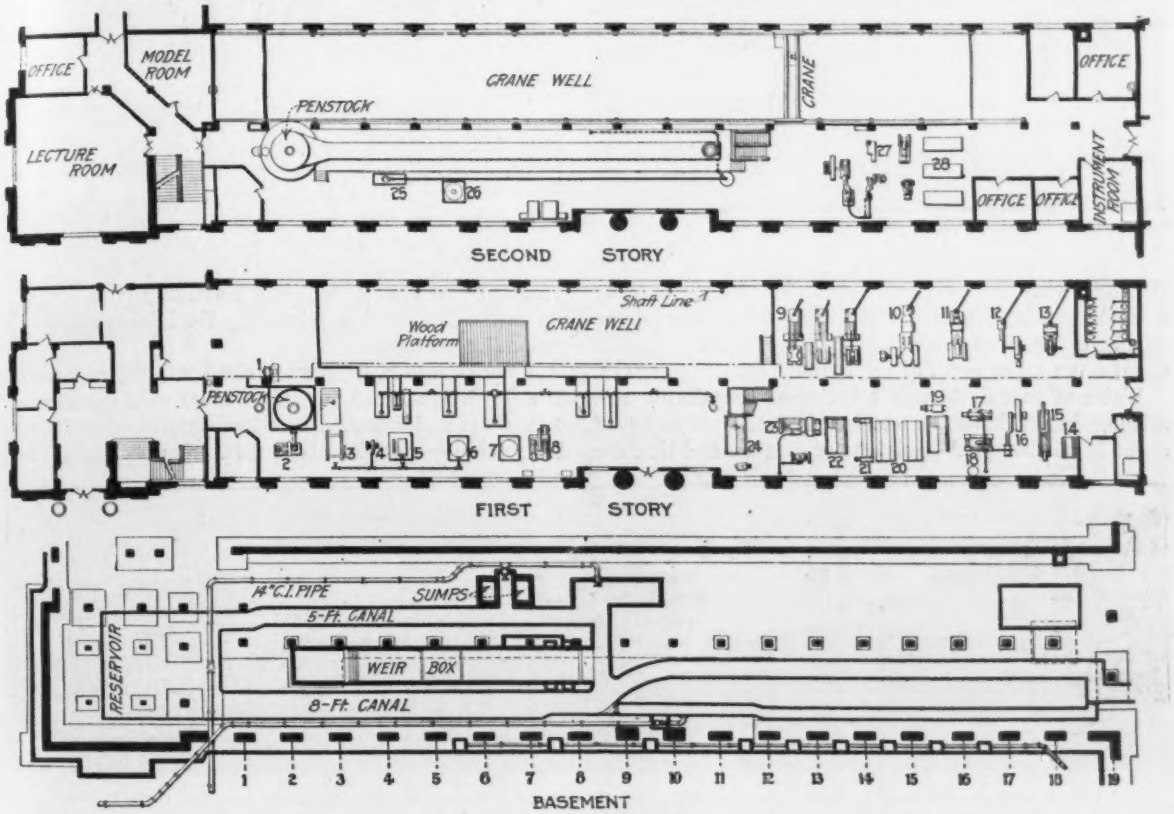
On the second floor is a 5x5-ft. steel canal, 135 ft. long, supplied through a 30-in. Venturi meter and stilling cone from the large centrifugal pump in the basement. This canal supplies the turbine penstock.

A 10-ton electric traveling crane runs along the ceiling of the second floor and half of the first and second floor is cut away for a length of nine columns to form a three-story crane well, into which a dray can be backed on the basement floor.

Testing-Materials Laboratory

The laboratory for the testing of materials is located in Building No. 5 (adjoining the hydraulic laboratory on the south). This laboratory occupies the whole of the basement and first floor and two-thirds of the second and third floors. In the basement is a laboratory for cement and sand accommodating twelve students. Here is a 50,000-lb. compression machine and space for mixing and storage rooms. The mixing space is served by a 10-ton crane, and has in it a mixer, bar bender, and form and material storage bins. Much of the space in the basement is taken up by foundations for heavy testing machines above and by machines for testing road materials.

On the first floor are the following machines: A 400,000-lb. universal Riehle, a 1,000,000-lb. Amsler-Laffon hydraulic compression, a 300,000-lb. Emery, a 200,000-lb. Olsen with extensions for transverse work, a 150,000-lb. rope tester, and a 100,000-lb. beam machine. All of these are served by a 10-ton crane. The rope machine has a special 2-ton traveler.



FLOOR PLANS OF HYDRAULIC AND STEAM LABORATORIES, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Machinery shown as follows: (1) 50-hp. motor, (2) Trump turbine, (3) (4) (5) impulse wheels, (6) (7) pressure tanks, (8) two-stage compressor, (9) Allis engine, (10) McEwen engine and generator, (11) Mackintosh & Seymour engine, (12) Corliss engine, (13) Curtis turbine, (14) air-storage tubes, (15) (17) (18) (19) air compressors, (16) Brown engine, (20) indicator tables, (21) Alberger condenser, (22) (23) Westinghouse engine, (24) launch engine, (25) hydraulic ram, (26) high-pressure tank, (27) small engines, (28) work benches

On one side of the third floor are three 75,000-lb. universal machines with overhead travelers. A cold bending machine, two machines for transverse tests on cast iron, an oil tester and several repeated-stress machines. On the other side of the same floor is a laboratory for heat treatment of steel, containing furnaces, pyrometers and tempering baths, grinding room, etc.

Many of the small testing machines are on the second floor, including the following machines: Three vertical and one horizontal wire, a wire-tension, a 20,000-lb. Riehle, a 50,000-lb. hand Olsen, a large, a medium and a small torsion machine, a 1000-lb. universal Riehle, and two 100,000-lb. universal Olsens. A removable floor allows access for the cranes to the several floors and basement. Travelers are placed above all of the larger machines.

Rebuilding the Omaha Water-Intake Cribs

By Geo. T. Prince*

SYNOPSIS—The timber and stone face walls of the twin intake cribs of the Omaha water-works have recently been faced and extended with a reinforced-concrete wall. A novel feature of the work was the formation of a coffer-dam, which was built into the lower part of the wall, by means of what were, for convenience, termed steel boxes. These boxes were composed, front and back, of interlocking steel piles sawed lengthwise, and on the sides, of steel lattice work, as described below. It may be added that these intake cribs are located on or near the shore line, instead of in the river.

The Metropolitan Water District of the City of Omaha supplies water for public and private use to Omaha, South Omaha, Florence, East Omaha and Dundee, having a total population of about 175,000. The source of the supply is the Missouri River at Florence, Neb., located about seven miles north of the business center of Omaha.

Water is passed through a series of coagulating and settling basins having a combined storage capacity of about 68,000,000 gal.[1] Sulphate of alumina and lime are used as coagulants, and before delivery into the supply mains, the water is treated with chlorine gas. The Florence Station, including the settling basins, was first used in 1889. The intakes at the river then consisted of two timber cribs (Figs. 1 and 3) of rectangular construction and dimensions sufficiently large to accommodate two 48-in. suction mains in each crib. Over each crib a building was constructed, in which were located the screens and necessary hoisting apparatus.

The walls of these intake cribs were built of timbers of large dimensions, well fastened together by iron drift bolts. The outer walls, next to the river, were extended as retaining walls along the river front, both above and below the two intake cribs, for a total frontage of about 180 ft., being back-filled with rock and earth and reinforced against overturning into the river by heavy horizontal iron rods extending well into the filled material and secured to suitable anchors imbedded therein.

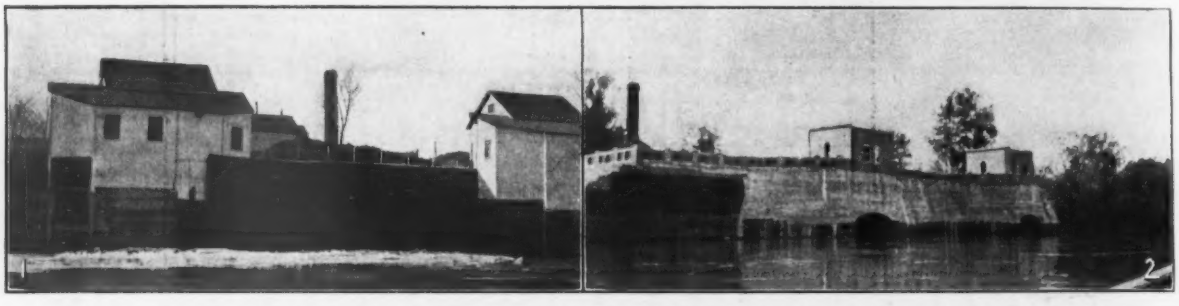
The outer, or river, face of this timber retaining wall was covered with ¼-in. iron plates securely bolted to the timber backing, as is shown in Fig. 5.

In 1914 it became evident that this timber retaining wall, as well as a large portion of the crib walls, would have to be replaced. The river at this point is about 1100 ft. in width; the bed of the river is of limestone which slopes gradually from the intakes to the north, south and east.

At the intakes the rock bed is practically at zero elevation, or city datum. The water in the river ranges between El. 7 and 24 ft., and for approximately eight months of the year, it is at about El. 13.

To make this reconstruction of a permanent character, reinforced concrete was adopted. Careful soundings along the retaining walls showed that the bed of the river was a water-swept rock bottom and practically level. Briefly, the method followed in rebuilding the intakes may be described as follows:

A row of 1½-in. holes was drilled into the rock bottom to a depth of about 6 ft. These holes were spaced about 4 ft. apart and extended in a line parallel with the timber retaining wall and about 6 ft. from the same. Into these holes were sunk 1¼-in. iron rods, having a length of about 12 ft.; hence the tops of these rods, when sunk to place, were about 6 ft. above the rock bed of the river. The space around the rods was filled with grouting applied through pipes extending above the surface of the water.



FIGS. 1 AND 2. ORIGINAL AND RECONSTRUCTED CRIBS OF OMAHA WATER-WORKS AT FLORENCE, NEB.
1—Original timber and stone cribs. 2—Reconstructed cribs with reinforced-concrete walls

Second-hand 12-in. steel sheetpiling was sawed into 15-ft. lengths. Each pile was then sawed along its longitudinal axis, and the ball half riveted to a ¼-in. steel plate, 4 ft. wide and 15 ft. long. The socket half of the pile was riveted to the other side of the steel plate, thus forming a pile about 4 ft. 7 in. in width, over all, and 15 ft. long, the steel plates constituting the web of the pile.

Two of these sheets or piles were placed 4 ft. apart and connected with lattice bars, thus forming a box approximately 4 ft. square. (See Section *AB*, Fig. 3, and the view, Fig. 4.)

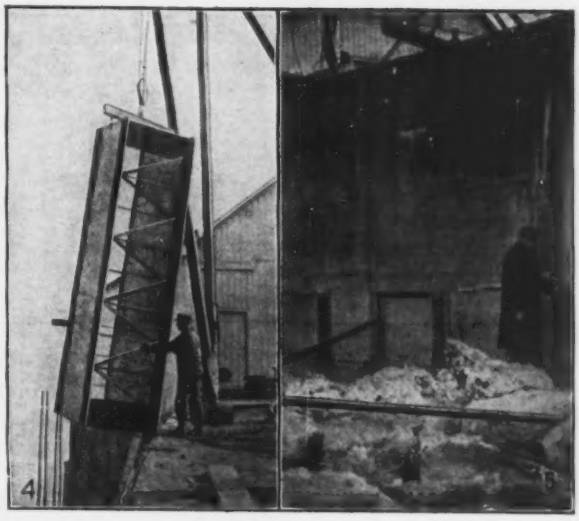
These boxes were sunk to the rock bottom, one of the iron anchor bolts, above referred to, being practically in the center of each box. Each section, or box, having its

*Chief Engineer, Metropolitan Water District of the City of Omaha, Neb.

[1]A basin now under construction will increase the capacity to 82,000,000 gal.

ball connection, was entered into and secured to the next box by the companion socket connection. When this row of steel boxes had been sunk in proper line, the boxes were filled with concrete, thus making a coffer-dam of concrete, 4 ft. thick and 15 ft. high, extending along and parallel with the old timber retaining walls and leaving a 4-ft. open space between the steel boxes and the timber retaining wall. This space was filled with concrete, but before the concrete was placed a row of 1½-in. holes was drilled into the rock bottom and along a line parallel with and about 1 ft. in front of the old timber wall. These holes were spaced from 2 to 4 ft. apart, dependent upon the character of the filling behind the old timber wall some of this filling being of large stone extending back more than 20 ft.; hence, the new wall did not require so much steel reinforcement to resist overturning into the river. Into these holes 1¼-in. iron rods 12 ft. in length were grouted in a manner similar to the rods referred to in anchoring the steel boxes.

The steel boxes near the end of the timber wall were drawn in toward the wall, thus forming a triangular structure, and were secured by suitable anchor bolts embedded through the old walls and extended into substantial filling to a good firm anchorage.



FIGS. 4 AND 5. STEEL-BOX INTERLOCKING PILES, OMAHA WATER-WORKS INTAKE WALL

4—Lowering one of the boxes to place. 5—Top ends of several boxes in place. See Section AB, Fig. 3, for position of boxes in finished wall

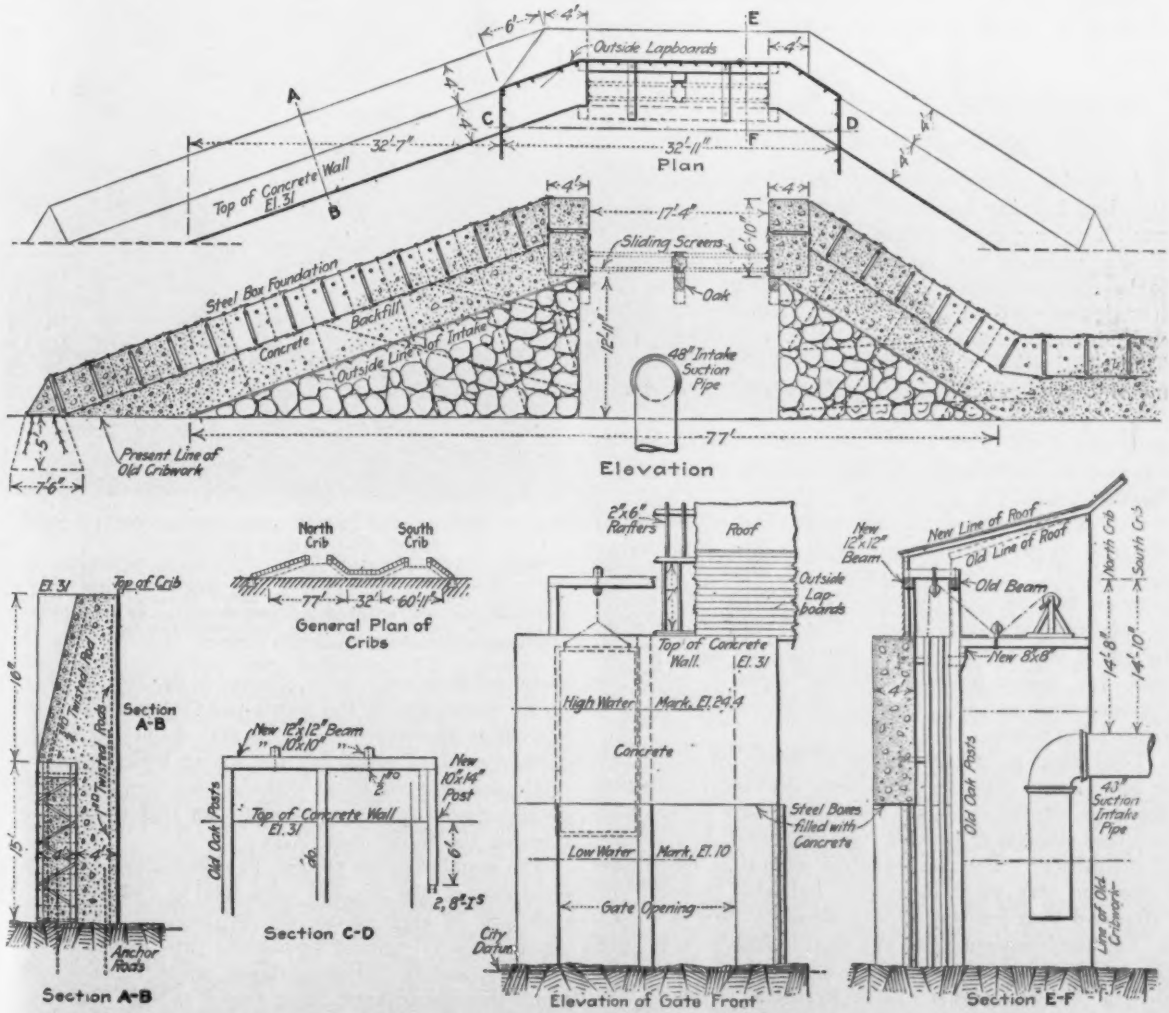


FIG. 3. DETAILS OF RECONSTRUCTED CRIBS OF OMAHA WATER-WORKS

The general layout is shown by the small sketch plan. The details relate to the north crib

With the boxes filled with concrete, there was formed a wall having a vertical face extending 15 ft. above the rock bottom. From this point the wall was extended for a distance of 16 ft. above the top of this box or 31 ft. above the rock bottom. The back face of the wall is vertical (see Section *AB*, Fig. 3). The wall has a width of 4 ft. on the top and is battered 4 ft. on the front or water face, from the top, for a vertical distance of 16 ft., so as to meet and conform with the front or river top of the steel boxes. Thus, the section of the completed wall is 4 ft. at the top at El. 31 ft. above river bottom, 8 ft. at El. 16 ft. below the top, or 15 ft. above river bottom, and 8 ft. at the river bottom.

Suitable openings were left for the admission of water into the intakes, with channel bars well anchored into the jams or sides of these openings for placing a portion of screens, over which were built brick houses.

The mixture of concrete used was 1:3:5. Much of the stone, however, was of large size, especially in that portion between the old wall and the steel boxes. A considerable portion of the filling was removed from the rear of the old wall and replaced by cyclopean masonry, which was possible after the construction of the coffer-dam formed by the steel boxes and filling.

It should be noted that conditions were very favorable for the type of construction which has been described.

Automatic Block Signals for Single-Track Railways

A special railway-operating condition which block-signaling is being introduced to meet is that of single-track lines carrying heavy traffic. Increasing the number of passing tracks may enable the number of movements to be increased, but with additional delay. The construction of a second track will both facilitate movements and eliminate the delays, but at very considerable cost. The introduction of the automatic block-signal system increases the facility and safety of operation at comparatively light cost, and greatly reduces delays, while it is quite conceivable that under some conditions it may so increase the capacity as to postpone the necessity for double-tracking.

One development of automatic-signaling equipment is designed to give special increase in facility of handling heavy traffic. Under this system each block (extending between two passing sidings) is subdivided by means of intermediate signals in such a way that two or more following trains may proceed through the block at one time (all under protection of the signals), while no opposing train can advance until all the other trains have cleared the block.

The system is "permissive block" in that it allows two or more trains (moving in the same direction) to occupy the block between sidings. The intermediate signals may be either absolute or permissive as prescribed by the rules of the railway. That is, the "stop" indication may mean "stop and stay until the signal indicates proceed," or "stop and then proceed under control." This is known as the absolute-permissive automatic block system, and the installations described below have been made by the General Railway Signal Co., of Rochester, N. Y.

The St. Paul and Duluth line of the Northern Pacific Ry., 163 miles in length, has a very heavy traffic for single-track, and the heaviest traffic occurs when weather conditions are unfavorable. The largest part of the traffic is in coal, and this is moved in greatest volume during the four months from November to February, at which time low temperatures prevail and storms are frequent. While the limit of single-track capacity had not been reached, and double-tracking was not an imminent necessity. It was desirable to increase the facility and safety of operation on this division.

One method of relief would have been to introduce the manual block system; but experience with this has not been favorable on the Northern Pacific Ry., where it has now been displaced almost entirely by the automatic block system (which aggregates 680 mi. of single track and 1180 mi. of line). As stated by officers of the railway, it has been found, so far as this railway is concerned, that the saving due to the reduction in the force of manual operators when the automatic system is installed is sufficient to pay for the maintenance of the latter. The decrease in pay of overtime to train crews due to the

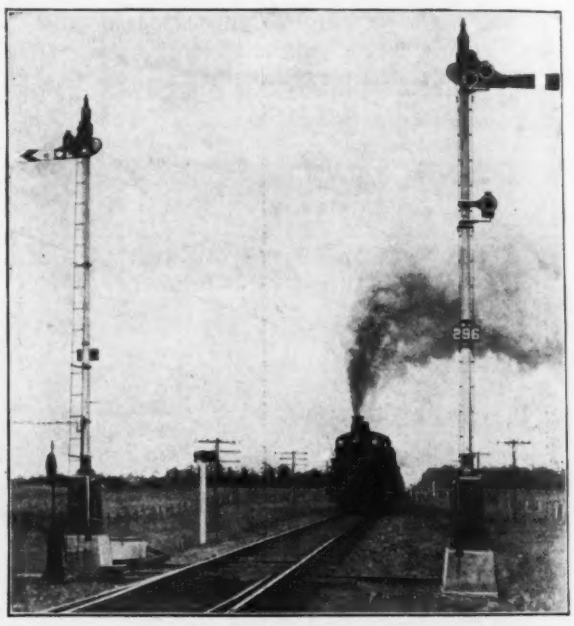


FIG. 1. AUTOMATIC BLOCK SIGNALS ON SINGLE-TRACK LINE; NORTHERN PACIFIC RY.

The entering signal at the left, governing the approaching train, is a "permissive" signal. Its position indicates "stop and then proceed into the block under control." The leaving signal at the left, governing opposing trains, is an "absolute" signal. Its position indicates "stop and remain until signal changes to indicate proceed"

expedited train movements is found to pay for the interest on the investment in the plant, while the increased safety (which is considered to be beyond doubt) is obtained without cost. The officials are strong believers in automatic block signaling and consider that they are justified in adopting it for other reasons than that of merely increasing the traffic capacity.

The installation on the St. Paul & Duluth line covers a distance of 146 mi., and has a total of 236 signals. At each end of each siding are two signals—the leaving signal, which controls movements into the block (say *B* to *C*), and the entering signal, which controls movements into the adjacent block (say *B* to *A*). The former is an absolute or stop-and-stay signal, distinguished by a square-end blade and a fixed red marker light vertically

below the main signal light. The entering signal is a permissive or stop-and-proceed signal, distinguished by a pointed blade. On some roads it has also a fixed red marker light below, but to the left of, the main signal light. This is not used on the Northern Pacific Ry.

The equipment at one end of a siding is shown in Fig. 1. At the right is the leaving absolute signal, in the "stop" position, and below it is the marker lamp. This signal indicates only "proceed" or "stop until signal clears." At the left is the permissive signal in the position indicating "stop and proceed." The approaching train will come to a stop and then proceed under control (as prescribed by the rules), prepared to find the block occupied or the track otherwise obstructed (by misplaced switch, broken rail, etc.). The intermediate signals are similar to the entering signal.

For opposing movements, the control of an absolute or leaving signal, and also the control of intermediate signals governing movements in the same direction, extends to the opposing leaving signal (at the other end of the block), and is effected by the track circuits. For following movements the control of all signals extends from signal to signal. For such movements the signal indicates "caution" if the next section of the subdivided block is clear and "proceed" if two sections of the block are clear. The signal indications are as follows: (1) "Stop and proceed," horizontal arm, red light; (2) "proceed but prepare to stop at next signal," arm inclined 45 deg., yellow light; (3) "proceed," arm vertical, green light.

The Lehigh & Hudson River Ry. has installed a similar block-signal system for about 72 mi. on account of heavy freight traffic and the necessity of providing for fast passenger service. The question of double-tracking had been considered, but it was felt that the limit of single-track capacity had not been reached, even without the use of signals. High-speed passenger trains had to be operated at night, however, and it was considered undesirable to handle such traffic without the protection of automatic signals, so that the signal installation was made primarily to protect and secondarily to facilitate the movement of traffic. The traffic averages 42 trains daily.

The installation is similar to that of the Northern Pacific Ry., but with some modifications. The absolute leaving signals are identical with those described in the foregoing, and one is shown at the left in *A* (Fig. 2). The permissive signal at the entrance to the block, however, serves also to govern movements into the siding. For this purpose it has a second (and lower) arm to indicate the position of the switch. This is shown at *A*, in Fig. 2. The arm is horizontal or inclined upward 45 deg., according as the switch is set for the main track or the turnout. The intermediate signals are shown at *B*.

The ordinary permissive signal at the "stop and proceed" position requires a train to come to a full stop before proceeding; but where the signal is on an ascending grade this might interfere with train movements due to the difficulty and delay of starting a heavy train on the grade. To meet this condition the signal at such a point is provided with a second (lower) arm, as shown at *C*, in Fig. 2. This arm is horizontal when the main (upper) arm indicates "proceed," but is inclined upward 45 deg. when the main arm indicates "stop and proceed." This special cautionary signal (known as a tonnage signal) permits the train to proceed slowly under control.

The control of the signals is as previously described. To provide against trains meeting at a siding and both being held by "stop" signals, the circuit for the entering signal at each end extends to the far end of the track circuit beyond the leaving signal at the opposite end. This overlap affords increased safety at meeting points. Opposing trains approaching a siding simultaneously would find the entering signals at the "stop" position, but as these signals are permissive, both trains can proceed slowly or under control after coming to a stop.

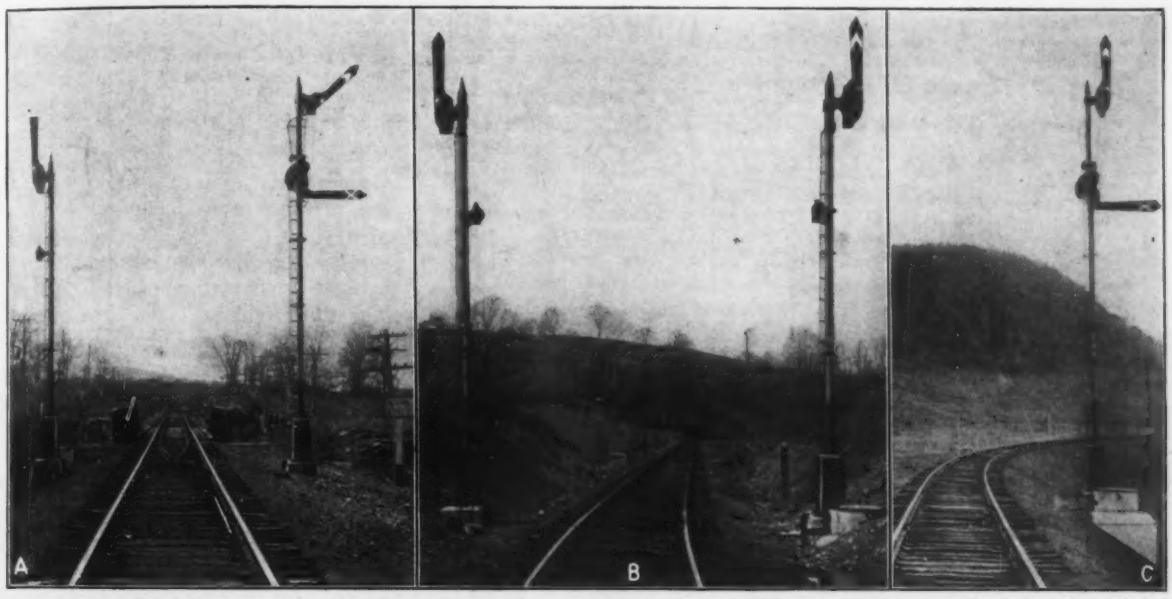


FIG. 2. AUTOMATIC BLOCK SIGNALS ON THE SINGLE-TRACK LINE OF THE LEHIGH & HUDSON RIVER RY.

A—Signals at end of block. At the right is the permissive entering signal, its inclined upper arm indicating "caution." The lower arm relates to the passing siding and indicates that the switch is set for the main track. At the left is the absolute leaving signal governing opposing trains. B—Intermediate signals, governing movements in opposite directions. C—Tonnage signal, installed where the intermediate signal is on a grade. It permits an ascending train to proceed slowly without coming to a dead stop when the signal indicates "stop"

A Variable-Capacity Hotel Sewage-Treatment Plant

By George L. Robinson*

To meet both an increased quantity of sewage and the demands of the State Department of Health some interesting additions have recently been made to a small plant built years ago to treat the sewage of the Buck Hill Falls Hotel & Cottage Community, at Cresco, Penn. Two new and larger settling tanks have been built and a sludge-and-scum-digestion tank, a sprinkling filter and a secondary settling tank have been added. The works are so designed that units may be cut out or cut in, as may be needed to meet seasonal changes in the hotel population.

The daily sewage production varies from about 2000 gal. in January to over 100,000 gal. in July and August. The sewage is carried through a 6-in. vitrified sewer from the buildings for a distance of about ¾ mi., with a fall of over 100 ft., to the site of the plant.

The original plant, which has been outgrown, consisted of a 5000-gal. stone-masonry settling tank, a 4000-gal. automatic-dosing siphon chamber, and seven sand beds controlled by gate chambers, the total area of the sand beds being 0.9 acre.

Old and New Settling Tanks

The Pennsylvania State Department of Health ruled that the period of retention in the tanks should be at least 6 hr. As the existing tank holds 5000 gal., the plant was designed so that two new tanks would act in conjunction with it, the idea being that the old tank would receive the sewage produced from the winter population, which might run from 0 to 150 persons. This would give a period of retention of 6 hr. for a maximum of 5000 gal. at the rate of 15,000 gal. per day of 24 hr.—that is, 10,000 gal. during the daytime and 5000 gal. at night. The second tank (new) will give a period of retention of 6 hr. for 15,000 gal. at the rate of 45,000 gal. per day of 24 hr.—that is, 30,000 gal. during the day and 15,000 gal. at night, taking care of a population of 450 persons. The third tank will act in a similar manner and the three together will take care of a population of 1050 persons, allowing a period of retention of 6 hr. and assuming 100 gal. per person per day.

The existing settling tank is 16 ft. long, 6 ft. wide and 8 ft. deep at the lower end. The new tanks are each 20x16 ft. in plan, with battered walls of concrete, as shown by Fig. 1. The floor and walls pitch sharply to one corner where the maximum depth of 10 ft. is reached.

The sewage enters each tank at the flow line, where the flow is regulated by a shear gate. Each tank is subdivided by means of two creosoted-plank baffles. At the low-level point of the floor a 12-in. iron draw-off pipe leads to the digestion chamber through the manhole outside, and at a point directly above, 12 in. below the flow line, another draw-off pipe, controlled by a shear gate, leads to the manhole. These pipes permit the withdrawal of floating scum on the top or sludge on the bottom of the settling tanks, as each tank is provided with these pipes.

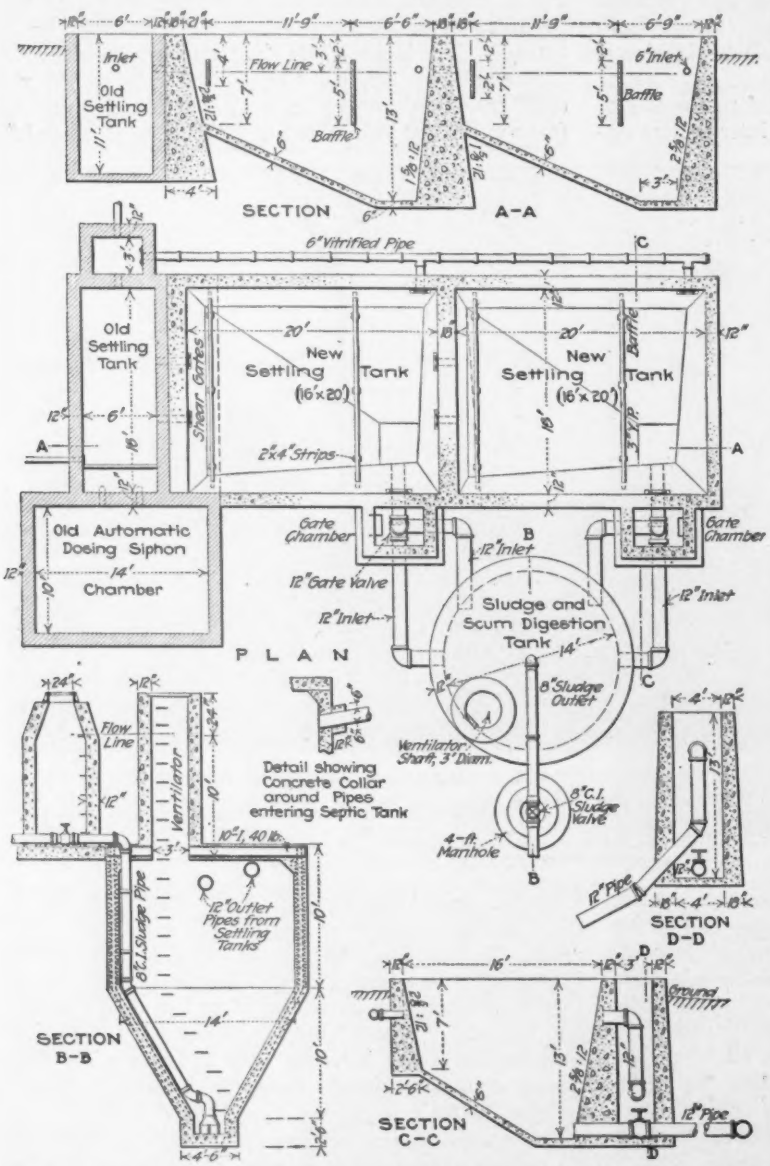


FIG. 1. OLD AND NEW SEWAGE-SETTLING TANKS FOR BUCK HILL FALLS INN, CRESCO, PENN.

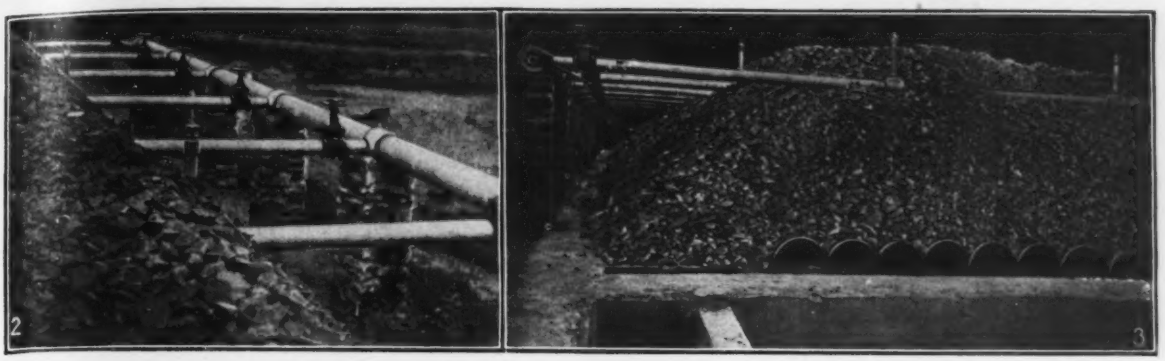
The digestion tank is a circular reinforced-concrete structure 14 ft. in diameter and 22 ft. deep at the maximum. There is a reinforced-concrete roof through which a gas vent manhole rises to a point 2 ft. higher than the flow line in the adjacent settling tanks. An 8-in. cast-iron sludge pipe extends from the bottom of

*Consulting Engineer, 37 East 28th St., New York City.

the digestion tank to a valve manhole where an 8-in. gate valve is placed.

It is proposed to draw the scum and sludge from the two settling tanks to the digestion tank, so that the theory developed in the Imhoff tank system may be closely approached for the disposal of sludge, at the same time taking advantage of the removal of the floating mat directly to the digestion chamber.

It will be observed that by keeping the valve in the sludge manhole closed and opening the valves from the settling tank it will be possible to develop a head which will permit the removal of sludge by closing the valve at the settling tank and opening the valve at the manhole beyond the digestion tank. This operation permits the digested sludge at the bottom to pass off to the drying bed beyond. The amount of sludge removed will equal the capacity of the gas manhole from the valve level to the flow line. In this way only digested sludge at the bottom will be removed, and with each discharge new scum may be drawn in from the settling tanks. It is expected to operate at frequent intervals, thereby keeping the settling tanks free from gasification and promoting digestion in the sludge tank.



FIGS. 2 AND 3. SPRINKLING FILTER FOR BUCK HILL FALLS INN SEWAGE-WORKS

Fig. 2—Feeder pipe on piers and nozzle-feed pipes with valves. Fig. 3—Nozzle-feed pipes, nozzles and underdrains

Sprinkling or Percolating Filter

The sprinkling filter has an area of approximately $^1/_{18}$ acre and will receive sewage at the rate of 1,800,000 gal. per acre per day, or 300,000 gal. per day per foot of effective depth. It consists (Figs. 2 and 3) of 3-in. broken stone, 5 to 6 ft. in depth, upon a 6-in. concrete floor, sloped for drainage. The underdrains are 12-in. half tile placed side by side the full length of the bed. The stone is allowed to take its natural slope on the outside—about 45 deg. Taylor hexagonal spray nozzles are used. They are 8⅔ ft. c. to c., and are underfed by 4 in. galvanized-iron pipe, which is supported on cast-iron saddles in 2-in. galvanized pipe brought up from the concrete floor. Each of the eight lines of distributing pipe heads in an 8-in. wrought-iron feed pipe. The supply to each 4-in. pipe is controlled by a valve.

Secondary Settling Tank

Beyond the sprinkling bed will be a resettling chamber of concrete, 20 ft. long, 15 ft. wide and 5 ft. deep, arranged with baffles so as to prevent the passing of floating humus.

It is proposed to operate the plant during the late fall, winter and early spring—when the population is at a minimum—with the present settling tank and sand beds. When the rate of 15,000 gal. per acre on the sand beds is reached the new settling tanks and sprinklers will be put in operation.

This plant was designed by Robinson & Wagner, Consulting Engineers, New York City. It was constructed by Charles N. Thompson and Harvey R. Springer, of the Buck Hill Falls Co., Cresco, Penn.

Tension Rivets Successful

Referring to the discussion current in *Engineering News* on the use of rivets in tension, their successful tensile service in New York Central railway bridges is brought to mind by C. R. Hill, of the bridge engineering department of that road.

It was common practice on the New York Central years ago to design railway bridge floors with sole reliance on rivets in tension to carry the floor. A typical case is bridge 660, crossing the Erie Canal at Newark, N. Y., built in 1863 and replaced in 1901. It was a 154-ft. double-track span of three trusses 16 ft. on centers, panel-length 6 ft. 8½ in. The floor consisted of 9-in. 30-lb. I-beams spaced about 27 in. on centers, *placed under the lower chord* and fastened by 1-in. rivets (in tension) through the horizontal leg of the chord angle and the top flange of the I-beams. Without impact, and assuming a reasonable distribution of the load, the computed stress on these rivets was about 6000 lb. per sq.in.

Further bearing on the same matter is the fact that cantilever brackets on many highway bridges, and practically all such brackets in buildings, depend on rivets in tension. Mr. Hill cites tests on rivets:

> **Tests have shown that the strength of the head is greater than the tensile strength of the shank; such tests were conducted by W. B. Petch, United States inspector of hull material ("Scientific Facts of Rivets," published by the Champion Rivet Co.), and by the German Government ("Der Eisenbau," 1912). The writer has recently made a number of laboratory experiments which confirm the results of the above tests whenever the material connected did not fail before the rivets, and found that rivets developed a tensile strength commensurate with that of the rod from which they were made.**
>
> **The writer does not advocate the use of rivets in tension when avoidable, but believes that when it is necessary to use them in this service they can be designed to carry their respective loads with safety.**

Coast Erosion and Protection on Long Island and New Jersey--I

By Gerald O. Case*

First of three articles on the general problem of coast erosion and protection, with special reference to the coasts of Long Island and New Jersey, where in recent years the damage to beach and beach structures has been so great as to demand immediate attention. The author is an English engineer who has for years specialized in the subject and who has written several authoritative textbooks upon it. He has been for several months past studying the problem presented by the Atlantic coast of the United States.

SYNOPSIS—Analysis of the causes of the littoral drift of sand along the coast, which is the primary manifestation of the erosion of the shore line. Study of the direction of this drift first on Long Island and next on New Jersey coasts. Cause of formation of sand spits and islands.

Littoral Drift

In recent years a very considerable amount of erosion has taken place on the New Jersey and Long Island coasts, resulting not only in the destruction of valuable property but also in the deterioration of the harbors. The material thus eroded is transported along the coast, accumulates inside the natural harbors and forms bars, which obstruct the entrances to the harbors, to the serious detriment of navigation. A careful study of the causes of littoral, or alongshore, drift is essential in order to enable engineers to design suitable works to combat the erosion and improve the harbor entrances and bathing beaches. In this article the subject of littoral drift will be considered.

Sources of Material Supply

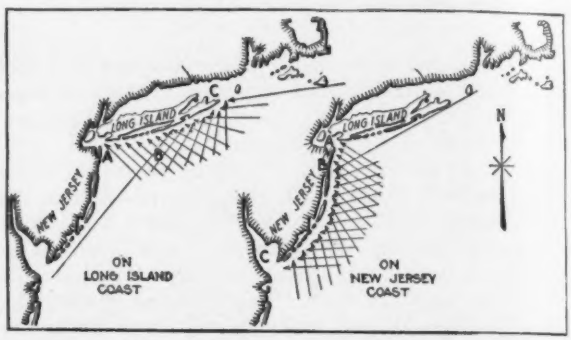
It may be stated as a general principle that the land is the only source of supply of material on these coasts. Numerous writers have expressed a doubt as to whether the vast deposits of sand, found on so many parts of the world's shoreline, are of recent formation. It is probable that at the breaking up of the glacial period the rate of sand formation was much greater than it is now.

At the present time sand and shingle are being formed by the erosion of the coast and attrition of detritus, and from the land surface by subaërial agencies. Attrition is constantly reducing the size of particles on the sea coast; but when the particles have reached the size of sand, attrition is then an almost negligible factor. This may be partly due to the particles being separated from one another by a thin film of water which prevents contact when in motion, or to the reduction of the violence of impact due to their very small mass. A balance may be struck when the particles are reduced to such a size that the impact is unable to disintegrate the material.

Subaërial agencies—wind, rain, frost, chemical action and running water—have a very powerful effect in eroding the land surface, and large quantities of silt and sand are transported from the land to the coast by rivers.

Littoral Drift Caused by Tidal Currents

The main currents produced by tidal action usually run parallel to the New Jersey and Long Island coasts, except close to the entrances to the inlets, where the flood current sets onshore and the ebb current offshore. In the last edition of the United States Coast Pilot it



FIGS. 1 AND 2. DIRECTION OF PREVAILING OBLIQUE WAVES ON COASTS OF LONG ISLAND AND NEW JERSEY

is stated that observations made between Nantucket and Cape May have developed the existence of weak tidal currents, veering round the compass, accompanied by a general drift southwestward amounting to about 7 mi. in 24 hours. The flood and ebb currents have, as a rule, nearly equal and very small velocities along the open coast, their velocities only becoming comparatively rapid at the entrances to the tidal inlets.

In the middle of the passage between Block Island and Montauk, at the northeast end of Long Island, the maximum surface velocity of the flood is about 2.5 ft. per sec. and of the ebb nearly 3.3 ft. per sec. Approaching New York harbor bar from the seaward the surface velocity of the flood current rarely exceeds 1.7 ft. per sec.; but the ebb current from the harbor, owing to its being reinforced by the river water, is about 10 per cent. more than the flood current, except near the Coney Island and Sandy Hook shores, where the velocities are about equal. At the Swash, Main and Gedney channels, at the entrance to New York harbor, the maximum surface velocity of the westerly flood current is 1.7 ft. per sec. and the easterly ebb current 2.1 ft. per sec. The flood current flows from two hours after low water to about high water and the ebb current from one hour after high water to one hour after low water. Assuming the bottom velocities to be about 80 per cent. of the surface velocity—and experience has shown this to be so for moderate depths—then even at the entrances to

*Consulting Engineer, Case Coast Protection Co., 2170 Broadway, New York City.

the wide inlets, where the currents are obviously swifter than along the open coast, the observed maximum velocities are only sufficient to move sand on the bottom by the formation and forward movement of sand ripples. A bottom velocity of about 2.4 ft. per sec. is necessary to destroy the sand ripples and move the sand in a continuous sheet.

Transportation of sand by currents with bottom velocities between 0.85 and 2.4 ft. per sec. takes place at a very slow rate. Experiments made by G. F. Deacon[1] showed that with a surface velocity of 1.5 ft. per sec. the velocity of motion of the sand was only $^1/_{2160}$ part of the surface velocity of the current, and at a surface velocity of 2 ft. per sec. the ratio was reduced to $^1/_{480}$.

Where there is a narrow inlet on the sandy beach and a large harbor or tidal reservoir, as is found in a number of places on the New Jersey coast, the tidal currents landward and seaward will have greater velocities near the entrance than at a wider entrance like New York harbor. In such cases the velocity of both flood and ebb is no doubt sufficient to move sand in a continuous sheet. As is well known, the transporting power of the ebb current through a narrow harbor inlet will exceed that of the flood owing to the gradient of the shore and the ebb being reinforced by land waters.

On the open coast the alongshore tidal currents oppose one another as transporting agencies, and owing to the gradient of the shore the tendency must be for material to move seaward.

There is little doubt that tidal currents along the open coasts of New Jersey and Long Island, unaccompanied by wave action and wind currents, have little direct effect in causing littoral drift, their chief effect being to transport material previously suspended or disturbed by wave action.

Littoral Drift Caused by Wind Currents

During gales wind-formed currents are created; and in tidal seas it is often difficult to separate the effects of such currents and tidal currents. In the author's opinion the effects of the wind-formed currents have been often underestimated. Many of the important shore features ascribed to tidal action by hydraulic engineers are produced on the shores of lakes and tideless seas by wind action alone. During gales alongshore wind-formed currents, especially when reinforced by tidal currents, have a powerful effect in causing the alongshore movement of sand and silt stirred up by breaking waves.

Littoral Drift Caused by Wave Action

Waves caused by an onshore wind which strikes the shore at right angles to the coastline do not themselves cause any alongshore movement of material, but owing to there being a surface current landward and a compensating undertow seaward, onshore winds cause the shore to be flattened out by dragging down material in a seaward direction. Waves which strike the shore at an oblique angle have, however, a very powerful influence in causing littoral drift. When an oblique wave breaks, the u sh travels up the shore at an angle. The velocity may be considered as the resultant of two components—one at right angles to and one along the shore. When the oblique wave travels up the beach the velocity at right angles to the shore is gradually destroyed by gravity, while the other component is unaffected, except by friction, the result being that a particle of sand or shingle is carried up in a curved path and down again; the individual path of each particle being approximately parabolic, such as is described by a projectile thrown at an angle into the air. Hence oblique waves cause a travel of material alongshore. The more oblique the impact of the breakers is to the coastline, the more powerful is their effect in causing littoral drift. The power of oblique waves to transport material alongshore is also dependent on the strength of the wind and the fetch or distance of open sea across which the wind blows before reaching the coastline.

In considering the movement of material by wave action it is important to keep in mind that the transporting power of waves rapidly decreases as the depth of water and distance seaward of low water increase.

After carefully studying the conditions on the New Jersey and Long Island coasts, the conclusion arrived at is that as a general rule the littoral drift is mainly due to oblique wave action. It must be remembered, however, that during gales currents greatly assist the movement of sand and silt suspended or disturbed by breaking waves. During gales, when oblique waves were moving material in an opposite direction to the flood tidal current, the author has frequently, at high tide, found an alongshore wind-formed current seaward of the breaking waves, which measurements showed to have a surface velocity of from 0.5 to 1.0 ft. per sec. in opposition to the normal flood current.

During onshore gales, when the waves and wind-formed currents themselves have no direct effect in causing littoral drift, sand is frequently moved alongshore in the direction of the flood current. This is due to the fact that in some places the flood current commences to flow an hour or more after low water, while the ebb current does not commence to flow until an hour or more after high water. On such shores the upper part of the foreshore is only acted upon by the flood current, and sand disturbed by the onshore breakers would be suspended and carried some distance by the flood current before being deposited; but the ebb current, flowing at its strongest when the upper part of the shore was bared, would have no effect in bringing such particles of sand back again.

It is important to bear in mind that there may possibly be some local exceptions to the general rule here advanced, that oblique wind waves are the chief cause of littoral drift on the New Jersey and Long Island coasts. Before designing any coast-protection works it is necessary to examine carefully the local conditions in each case, in order to determine with certainty the relative effects of wind waves and tidal currents in causing littoral drift.

Littoral Drift Caused by Wind

At low tide oblique and onshore winds transport sand from the foreshore to the land. The chief effect is to erode the foreshore between the tide limits and build up above high-water mark sand dunes, which will themselves be moved inland in course of time, unless overgrown by vegetation. The erosion of the coast resulting from the formation and inland movement of sand will

[1] Minutes Proceedings, Institute of Civil Engineers, Vol. CXVIII.

be dealt with in the article on the causes of coast erosion.

If, as already stated, oblique wind waves are the chief cause of the littoral drift, then the direction of predominant drift should be in the direction of the prevalent or strongest waves causing the formation of such oblique waves.

Littoral Drift Off Long Island

Fig. 1 shows the action of oblique waves on the south coast of Long Island. It will be noticed that the shore is sheltered from the northeast winds, while the south and southeast winds, which strike the shore almost at right angles to the coast, will have little or no effect in causing littoral drift. The winds which will cause the formation of oblique waves are those coming from the east-northeast, east-southeast and southwest. Reference to the map will show that the section of shore from *A* to *B*, while sheltered from the southwest oblique waves, is exposed to those from the east-southeast and east-northeast, while the shore from *B* to *C* is exposed to oblique wind from the east-southeast, east-northeast and southwest. It is therefore reasonable to suppose that the predominant drift will be from *B* to *A* and that the drift between *B* and *C* will depend on the relative strength and duration of the winds causing oblique wave action in opposite directions.

While the northerly winds predominate on this coast, it will be noticed that the shore at the northeast end of Long Island is exposed to a greater range of winds capable of causing oblique wave and littoral drift in a northeasterly direction than to winds capable of causing littoral drift in a southwesterly direction. Moreover, the distance of fetch or open sea between New York harbor and the northern part of Long Island will enable the winds blowing from the west-southwest to cause oblique wind waves capable of effecting a certain amount of drift.

We may therefore expect that the direction of littoral drift will not be very clearly defined, but that near the northeast end of the Island it will probably be found to be from southwest to northeast.

A study of the local conditions shows there is abundant evidence that the predominant drift is from *B* to *A*. The spits and sand islands[2] in front of Fire Island, Jones and East Rockaway inlets have all moved in a westerly direction. According to the *Coast Pilot*, the spit in front of Fire Island inlet has for many years been moving westward at a fairly uniform rate. From this inlet to Coney Island the evidence of a predominant westerly drift is everywhere apparent. Between Fire Island inlet and the northeast end of the island the evidence of a predominant drift is not very clear. It appears that at Shinnecock Bay a spit may possibly have grown out from both sides of the bay, as the entrance is about in the center; but there is no conclusive evidence that this is so.

Littoral Drift Off New Jersey

Reference to Fig. 2 will show that from *B* (Bay Head) to *A* (Sandy Hook) the New Jersey shore is to some extent sheltered from oblique waves formed by northerly winds and exposed to oblique waves from the south and southeast; while the shore from Bay Head to *C* (Cape May) is exposed to oblique wave action caused by both northeast and southeast winds. As the northerly winds predominate, we may expect to find the littoral drift to be in a southerly direction from some point near Bay Head to Cape May and in a northerly direction from Bay Head to Sandy Hook.

A careful examination of the local conditions shows that this is so. Everywhere between Bay Head and Sandy Hook we find evidence of a predominant northerly drift.

A study of the reports of the U. S. Weather Bureau, shows that, between Long Branch and Sandy Hook, during the summer months, the prevalent oblique onshore winds are from a southerly direction causing a northerly movement of material. In the winter months northwest winds predominate and have little direct effect in causing littoral drift. Very severe winds from the east-northeast occur during the winter, but owing to the trend of the coast do not strike at a very oblique angle and cause a seaward movement of material. The amount of littoral drift taking place during such storms is insufficient to compensate for the drift caused by the prevalent southerly onshore waves.

Sandy Hook spit has gradually advanced toward the Long Island coast. A comparison of Keith's survey made in 1685 and the coast survey of 1885 shows that between these dates the northward advance has been about 4700 ft. Surveys made between 1836 and 1885 indicate that the spit sometimes increased in length and sometimes decreased, the net result being a northerly growth of about 300 ft. between the above-mentioned dates.

Formerly the Shrewsbury and Navesink Rivers had their outlets across the neck of the spit, but these have been dammed up by the littoral drift and the outlets for their waters driven northward along the land side of Sandy Hook.

The spit in front of Shark River has steadily worked northward until it has closed up the outlet; after a time a new outlet was formed further south during storms and floods or one has been artificially formed. In 1890 the outlet was closed by the northerly drift, and a new outlet was cut further south. This outlet immediately started to move northward, the movement being at the rate of about 20 ft. a day during a week when the outlet was under observation.[3] The spit in front of the Manasquan River outlet has also progressively moved northward until a new entrance has been formed to the southward by storms and floods, when the new entrance commenced to move northward again.

Everywhere between Bay Head and Sandy Hook we find evidence to prove that the predominant drift is in a northerly direction. South of Bay Head, on the contrary, we find conclusive evidence of the predominant drift being in a southerly direction.

Barnegat inlet moved southward about 2300 ft. between 1840 and 1874, the spit at the northside of the inlet advancing southward and erosion taking place on the south side, the width of the inlet remaining about the same.[4] Long Beach by its southern movement has

[2]The term "spit" is here used to designate the long sandy formations which have grown out across the inlets and locally termed "beaches." In places where the spit has been cut through and an island formed the term "sand island" is used.

[3]"Transactions," American Society of Civil Engineers, Vol. 23.

[4]Report of New Jersey State Geologist, 1905.

become joined to what was formerly Tuckers Island. In 1841 Little Egg inlet between Long Beach and Tuckers Island was about 7200 ft. wide; by 1885 the points of land had become joined together. Between 1772 and 1885 Five Mile Beach on the east shore of Cape May had moved southward about 3750 ft. At Great Egg harbor the "new inlet" which intersected the beach near Longport progressed to the southward until it joined the old inlet about the year 1859.[5]

Formation of Sand Spits and Sand Islands

The general tendency is for the sea to fill up the bays and plane down the headlands. Spits in front of bays and estuaries are formed where there is a predominant drift. If there is an abundant supply of littoral drift and an embayment in the coast, the sand is moved by wave action and currents in a more or less continuous manner, and instead of being moved back into the reëntrant angle is often built out in the form of a long spit. The action of oblique waves and currents is alone instrumental in building the spits or sand embankments which border the New Jersey coast up to the level of about low-water neap tides. After that level is reached the wind plays an important part in their formation. At low tide the onshore winds blow sand against the sea-constructed bank and wind-formed dunes are then brought into existence.

On the New Jersey coast the sand spits are mainly formed by littoral drift transported by oblique wave action, although assisted by currents. The formation of Sandy Hook has frequently been attributed primarily to tidal currents. In a report to the Coast Survey, 1856, it is stated that "it turns out that the growth of the Hook . . . goes on regularly and according to determinable laws. The amount of increase depends upon variable causes . . . and the cause of this is a remarkable northwardly current . . . along the shores of the Hook. For more than seven hours out of the twelve there is a northwardly current through the False Hook Channel. This northward current runs inside for eleven hours out of twelve. It is this conflict of these two northwardly currents outside and inside and the deposit of material which they carry to the point of the Hook which cause its growth."

As the cause of the littoral drift is a matter of considerable importance, the author has carefully looked into the latest available Government information about the tidal currents on this part of the coast. On the outside shore of Sandy Hook the flood and the ebb have practically the same velocity, while the ebb flows for a little longer time, and is in fact slightly more powerful, there being a general drift in a southerly direction amounting to about 7 mi. in 24 hr.[6] The flood and the ebb, therefore, oppose each other as transporting agencies. It is true that the upper part of the shore is only acted upon by the flood current, as the ebb commences to flow about one hour after high water; but from one hour before to one hour after high water the velocity of the flood current is very small, and it is doubtful if it is even sufficient to move sand by the slow forward movement of sand ripples. The maximum velocity of the flood current at the entrance channels to New York Bay is two hours before high water on the part of the shore, which is also acted upon by the ebb current. In the author's opinion it is physically impossible for Sandy Hook to have been formed primarily by the tidal currents, and that its formation is due to littoral drift caused by oblique wind waves and tidal and wind currents.

A spit built out across a bay may, in course of time, extend right across and form a lake behind it. Southward of Sandy Hook many bays which formerly indented the coast have been closed up by the formation of spits which have grown right across. Lakes have thus been formed at Elberon, Deal, Asbury Park, Ocean Grove, Ocean Park, Lake Como, Spring Lake and Seagirt.

Where a considerable quantity of land water drains into a bay or indentation, the land water may at times of flood break through the sand spit in one or more places. Where rivers discharge into bays the sea is often unable to maintain a continuous spit across, and during floods the river water may break through it in one or more places—long, narrow sand islands being thus formed. Spits in front of Shark and Manasquan River outlets have, as previously mentioned, been constantly breached and then built up again by littoral drift. History also shows that the Sandy Hook spit between Low Moor and its extremity has been broken through on several occasions, when the waters of Shrewsbury river would for a time empty directly into the sea.

On the Atlantic coast of America we frequently find a series of elongated sand islands more or less inclosing lagoons. In fact, such sand islands are more characteristically exhibited on the Eastern coast of the United States than on the coasts of other continents. These sand islands will often travel across the bay and join on to the coast, or the sand islands themselves may unite.

Where rivers discharge, the position for the entrance of the tidal waters and the exit for the river waters are in many places constantly changing; as while the sea is endeavoring to close the bay by a continuous sand embankment along which it can move fresh supplies of material, the land waters are trying to find an outlet. In many cases it is a continuous warfare, in which neither side is entirely successful.

Where there is an inlet or harbor having a narrow entrance, the flood current sets into the harbor, and during gales when the waves on the coast stir up material the current carries in suspension large quantities of silt and sand. At slack water this material is deposited in the harbor or inlet, especially where salt marsh plants have obtained a footing. This material is not picked up again by the ebb current, there being no wave action to stir up the material on the sheltered inlet, and consequently salt marshes form and increase in area. At and near the entrance to the inlet the ebb currents are more powerful than the flood currents owing to the gradient being seaward and to their being in many cases reinforced by land water.

The growth of a spit across an inlet by narrowing the entrance and increasing the size of the tidal reservoir increases the tidal scour at the entrance and may prevent the further growth of the spit alongshore, in which event an apposition form of spit is formed as at the extremity of Sandy Hook. The formation of salt marshes inside the harbor or under the shelter of the spit, on the other hand, tends to decrease the volume of tidal water, and consequently the scour.

[5] Report of New Jersey State Geologist, 1885.
[6] "United States Coast Pilot," Vols. IV and V.

Maintenance and Repair of Asphalt Block Pavements

By Edwin J. Morrison*

SYNOPSIS—Explicit directions for the repair and maintenance of asphalt-block pavements by an engineer of over 20-years' experience in the asphalt-block industry. Renovating old asphalt-block pavements by a surface treatment of asphaltic oil.

There are three principal things to be guarded against in the maintenance and repair of asphalt-block pavement: (1) Allowing small defects to go unrepaired until they grow into actual holes in the wearing surface; (2) making an incomplete, and therefore ineffectual, repair by simply "plugging the hole" and failing to make a repair of sufficient area to restore the surface of the pavement to its original grade and contour; (3) neglecting or failing to utilize the old blocks in a proper and effective manner.

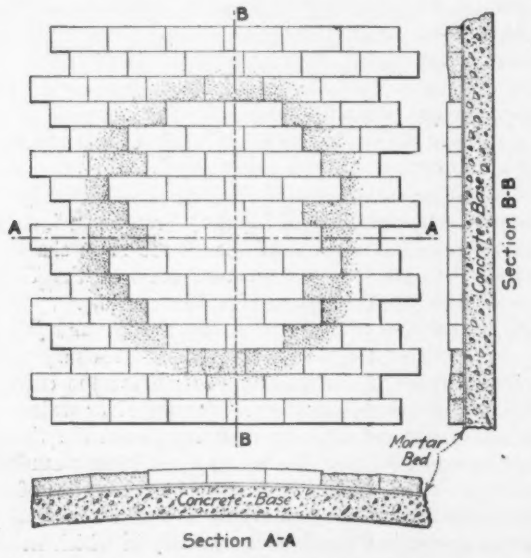


FIG. 1. WRONG WAY TO MAKE PATCHES IN ASPHALT-BLOCK PAVEMENT

Large numbers of old blocks, which properly relaid with asphalt-filled joints would have given good service for many years, have been thrown away; and in many cases where they have been used the relaying has been carelessly done and the joints filled with sand, leaving the blocks peculiarly susceptible to deterioration during winter weather.

The maintenance work, under the supervision of the writer, has averaged for a number of years somewhat over 1,000,000 sq.yd., and in speaking of the serviceability of the old blocks properly relaid and the economy resulting from careful attention to this feature of repair work he is speaking from a practical and well developed experience and not advancing a new or untried theory.

Blocks that are ten or more years old are generally hard and "dry" (the reason for which will be described later), and in taking up and relaying them the edges and corners are liable to be damaged. If the joints are simply filled with sand, the edges crumble under traffic, producing a rough and unsightly surface. The only proper method of treating the joints is by the use of an asphaltic filler. Where the joints are large or the edges and corners badly chipped, they should be filled with dry trap-rock grits before pouring the asphaltic filler. The joints should be made water-tight. The asphaltic filler is spread out by traffic, thus protecting the surface of the block as well as the joint.

The importance of treating the joints in this manner cannot be overstated. Such a repair results in a smooth surface, which under the action of traffic renders the patch indistinguishable in a very short time, whereas a patch made with the same blocks, with sand-filled joints, generally produces a rough surface with a percentage of bad joints which are subject to deterioration under traffic during the winter. The cost of applying the asphalt filler (which will be described later) is small and insignificant when balanced against the benefits accruing from it.

In making repairs to asphalt-block pavements the old blocks should be used to the utmost extent, and the new ones should be placed in continuous areas by themselves. The old blocks which are of the same formula, age and wearing quality will thus be brought together, and from the new blocks, laid by themselves, will be derived their utmost serviceability.

Contrary to much that has been written and said, the old blocks can be utilized to a very great extent in making repairs, if proper attention is paid to this point. Practically every whole block can be salvaged and efficiently used. This is true even where the blocks have one surface badly mutilated and are of unequal thickness, since the bad and irregular surface can be bedded in the mortar and the smooth surface of the blocks exposed to traffic.

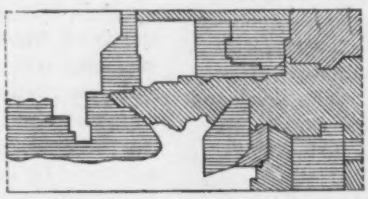


Fig. 2

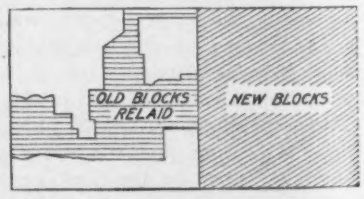


Fig. 3

FIG. 2. INEFFECTIVE PATCHES IN AN ASPHALT-BLOCK PAVEMENT

	Sq.Yd.	Per Cent.	Unit Price	Total Cost
Repaired with new block	129.6	64.8	1.60	$207.36
Original surface not repaired	70.4	35.2	....	.....
Totals	200.0	100.0	....	$207.36

FIG. 3. CORRECT METHOD OF REPAIRING AN ASPHALT-BLOCK PAVEMENT

	Sq.Yd.	Per Cent.	Unit Price	Total Cost
Continuous repairs with new blocks	93.3	46.65	1.60	$149.28
Repaired with old blocks	43.1	21.55	0.60	25.86
Original surface not repaired	63.6	31.80	....	.....
Totals	200.0	100.0	....	$175.14

*President of the Hastings Pavement Co., New York City. President of the Asphalt Block Pavement Co., Toledo, Ohio.

The sketch (Fig. 1) illustrates an incomplete repair, the unshaded surface representing new blocks and the shaded area showing old blocks left in their original position, slightly depressed. These should have been taken up and relaid, restoring the pavement to its original contour. Such an incomplete repair has generally resulted in unnecessarily rapid wear of the old blocks which are left in a slight depression around the original patch.

The sketch (Fig. 2) shows an actual condition on a street in the Borough of Manhattan, New York City, where the foundation was found to be very defective. The

FIG. 4. CONDITION OF OLD ASPHALT-BLOCK PAVEMENT BEFORE TREATMENT

hatched areas indicate a series of individual patches made during a period of about two years, resulting in a gross repair, aggregating 64.8 per cent. of the area shown, made entirely with new blocks. This made an irregular and unsatisfactory surface, because the individual repairs were of the kind indicated in Fig. 1.

Fig. 3 indicates what should have been done with this particular section of street. The hatched area marked "new blocks" contained many small depressions and defects. This area should have been taken up from curb to curb and repaved with new blocks to perfect line and grade in one operation. Of the old blocks removed there would have been more than enough of good quality to make the repairs in the area indicated as "old blocks relaid," and the result would have been satisfactory.

The method indicated by Fig. 2 resulted in an unnecessarily large use of new blocks, in no utilization of old blocks at all, and in a relatively unsatisfactory pavement surface; while the method indicated by Fig. 3, although requiring a much smaller expenditure of new blocks, would have placed them in one continuous area with perfect surface, utilizing at the same time a considerable percentage of old blocks, which in the other case were thrown away. The net result at prevailing unit prices for new blocks shows a saving in cost of over 15 per cent.

While a small section of pavement requiring unusually extensive repair has been taken for illustration, it serves very forcibly to indicate the ultimate, if not the immediate, economy of making a complete repair of defective conditions, thus saving and utilizing much old material instead of making a partial repair and allowing the small defects to go until they result in complete destruction of the surface.

The repair and treatment of asphalt blocks for maintenance purposes cannot be scientifically handled without some knowledge of the physical characteristics of the blocks themselves. This makes it important to review briefly the history of asphalt blocks and to show the general trend of the varying methods and formulas used during the past 20 yr.

Character of the Old Blocks

Asphalt blocks began to be used extensively in New York City about 1895. At that time, and for a period of about 10 yr., the asphaltic cement was prepared by fluxing refined "Trinidad" asphalt with from 6 to 8 per cent. of Pennsylvania or Ohio residuum oil, of 22 to 24 deg. gravity Bé. This resulted in a very hard cement, gradually growing harder with the lapse of years as the volatile matter in the flux oil evaporated. The hard blocks had a tendency to brittleness during the winter. In order to overcome this tendency a larger amount of heavier flux oil was used.

During the transition period which followed, the fluxing material was varied by using 9 per cent. of Ohio residuum oil of from 16 to 18 deg. Bé., 12 per cent. of 14 deg. Bé. oil and from 16 to 18 per cent. of 10 to 12 deg. Bé. asphaltic base oil. This process of evolution ended in the adoption, about 8 yr. ago, of a semiliquid flux derived from an asphalt—base oil, treated with air, steam or sulphur.

A fluxing material produced in this manner has all of the lighter volatile oils removed in the process of preparation and is very stable, being but slightly affected by temperature changes, and it does not liquefy under summer heat. These changes in the fluxing material, together with other changes in the kind and quantity of filler used and the grading of the mineral aggregate, have resulted in a gradual increase of bitumen in the block, accompanied by a gradual softening of the asphaltic cement, as indicated by the penetration.

We now know from the experience of later years that all the old blocks were not only too hard when they were made but have been gradually increasing in hardness

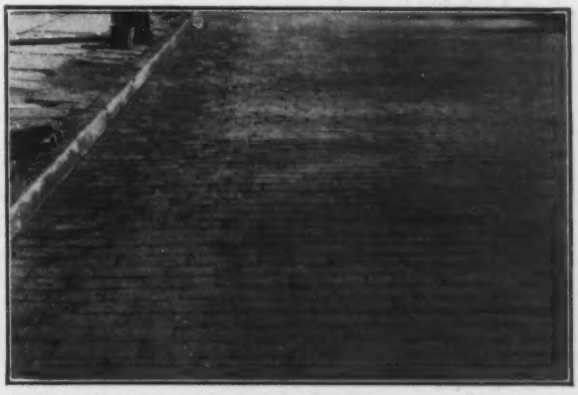


FIG. 5. PAVEMENT AFTER REPAIRS HAD BEEN MADE

ever since. This defect is cumulative in its effects, resulting in a chipping of the joints in winter and in the course of time in a pitting and scaling of the entire surface of the block; although otherwise these old blocks have, in a majority of cases, given excellent service.

Surface Treatment

The brittle condition of the old blocks led to the inauguration, some two or three years ago, of a series of experiments to determine a satisfactory and economical method

of surface treatment which would soften the hard asphaltic cement and prevent the chipping of the blocks in winter. These experiments embraced the use of a great many materials, applied in many different ways and under widely varying conditions. Complete success has been attained, and while a different treatment has to be applied to suit varying conditions of traffic and of the old blocks to be treated, the basic principle is substantially the same for all.

The method which experiment and experience have shown to produce the desired result is to dissolve a heavy bituminous oil in a volatile solvent and apply it to the

FIG. 6. RELAYING OLD BLOCKS IN GUTTERS

surface of the old blocks in the form of a thin wash or paint coat, giving one or more applications, as considered necessary. The solvent penetrates a considerable distance into the blocks and then evaporates, leaving a coating of heavy stable bitumen, which mixes perfectly with the old asphalt softening and giving it new life, while producing a malleable surface on the old blocks very similar to that produced by the formulas now used in the manufacture of new blocks.

After the application of the paint coat the entire surface of the pavement should be covered with a very thin layer of dry, fine trap-rock screenings, passing a ⅛-in. mesh screen; or any clean, dry sand will answer the purpose if trap rock is not available. The fine trap rock, sand and dust serve the double purpose of preventing the oil from being picked up by the shoes of pedestrians and tires of vehicles and, what is more important, cause the oil to be ground by traffic into the joints and inequalities of the surface. Where the joints are only slightly broken down this simple application is all that is needed to restore the surface of an old asphalt block pavement to a satisfactory condition. The cost of this surface treatment when applied to large areas will range from 2 to 4c. per sq.yd.

Brooklyn Example

Eighteenth St., from Sixth Ave. to Prospect Park West, covering an area of over 7000 sq.yd., was paved in 1906 with 3-in. asphalt blocks on a concrete foundation (by a company then just starting in the asphalt-block business). The materials and methods of manufacture were poor, and the condition of the surface of this street became so bad by 1914 that it was considered useless to make further repairs in the old way. It was admitted, however, that if the blocks could be saved and utilized by a surface treatment the value of the treatment would be fully demonstrated.

A contract was accordingly awarded in the summer of 1914, but on account of unexpected delay the actual work could not be started until Oct. 30, and it was not finished until Nov. 28, under somewhat unfavorable weather conditions. This work was done under the supervision of Herman H. Schmidt, Chief Engineer of the Bureau of Highways, by the Hastings Pavement Co.

The parts of the specifications covering the taking up, culling and relaying of old blocks and the special asphaltic filler for the treatment of joints follow:

The work shall consist of the removal of the present asphalt-block pavement and mortar bed; the repair of the present concrete foundation; the repaving of the roadway with asphalt blocks made up in part by new blocks and in part by old blocks taken from the present pavement, the treatment of the surface of the old blocks and all work incidental thereto, all in accordance with the plans and specifications on file in the Bureau of Highways, and over such areas as the engineer may direct.

The thickness of the mortar bed used under the culled blocks which are repaved over the above areas shall be approximately ½ in., but sufficient to bring the upper surface of the relaid blocks to an even grade with the adjacent pavement surface.

The asphalt blocks forming the present pavement, as taken from the street, shall be carefully culled and blocks which show a depth of 1½ in. or over and are otherwise suitable shall be piled separately and used for repaving.

The old asphalt blocks which can be used again shall be used to repave such areas as the engineer may direct. In addition the contractor shall furnish and lay, as directed by the engineer, new asphalt blocks, which shall conform in all particulars with the current asphalt block specifications of the Bureau of Highways, Borough of Brooklyn, which, so far as they apply, are made a part of this specification.

The surface of the present pavement which has not been disturbed, and those areas which have been repaved with blocks culled from the present pavement, shall be thoroughly broomed over with steel brooms and the joints cleaned and freed from all dirt and loose material.

Into the joints between the blocks shall be poured quartz gravel, crushed granite or trap rock, which shall be clean, approximately cubical, free from all foreign materials and

FIG. 7. JOINTS FILLED WITH ASPHALT AND GRITS

shall pass a ¼-in. mesh screen and be retained by a 20-mesh screen. It shall be artificially heated and dried in proper appliances placed near the work before being placed in the joints, if required by the engineer.

Immediately following the application of the gravel the joints shall be poured with an asphaltic cement conforming to the following requirements:

The block filler shall be a "blown" asphaltic oil product, or residual asphalt: (a) It shall contain not less than 99 per cent. of bitumen soluble in carbon bisulphide. (b) It shall contain not less than 98½ per cent. of total bitumen soluble in carbon tetrachoride. (c) It shall have a penetration at 77 deg. F. under a load of 100 grams for 5 sec. of not less than 55 nor more than 75. (d) It shall have a penetration at 32 deg.

F. under a load of 200 grams for 60 sec. of not less than 25. (e) It shall have a penetration at 115 deg. F. under a load of 50 grams for 5 sec. of not more than 200. (f) It shall have a ductility at 77 deg. F. of not less than 5 cm. nor more than 25 cm.

When these specifications were prepared it was expected that the work would be done in midsummer and that the treatment of the joints, as previously described, would be sufficient for their protection, and that the summer traffic would distribute the asphaltic filler over the surface of the blocks sufficiently to protect them against any tendency to pit or rough up during the succeeding winter.

This treatment would undoubtedly have been sufficient if the work had been done in midsummer, but as it was actually done in the cold weather of late November it was considered advisable to add to the treatment described

FIG. 8. PAINT COAT WITH SPRINKLING OF GRITS

in the specifications a surface treatment of the entire area of old blocks. This consisted of a paint coat composed of crude oil and a heavy asphaltic maltha of about 12 deg. gravity Bé., mixed half and half, applied hot and squeegeed over the surface, followed by a thorough sprinkling with fine trap-rock grits and dust passing a 20-mesh screen.

The result demonstrated fully the value of the treatment. The old blocks passed through last winter without exhibiting in the slightest degree any of the former tendency to break down at the joints or to pit on the surface.

The conditions on this street were peculiar in that certain sections and areas of the blocks showed very much more serious wear than others. These worst areas are fairly illustrated by Fig. 4. These areas were, of course, selected for taking up the old blocks from curb to curb, for the conditions were such that no amount of patching could produce a satisfactory surface.

On other parts of the street the general surface of the pavement was in very good condition and the original contour very well maintained, except for small defects here and there, particularly along the gutters. These portions of the street were repaired as shown in Fig. 5, by patching the defective places with old blocks reclaimed.

The sequence of operations is the relaying of the old blocks along the gutter (Fig. 6), spreading the trap-rock grits over the surface, filling joints with the trap-rock grits, the surplus being swept off; pouring of joints with the asphaltic filler, the surface treatment and application of the paint coat (Fig. 8), and finally covering with trap-rock grits (Fig. 7).

The area treated was 7184 sq.yd., of which 3022 sq.yd. was repaved with new blocks; 752 sq.yd. of old blocks were relaid and 3358 sq.yd. of old blocks were left in their original position, receiving only the joint and surface treatment. Thus 57 per cent. of the old blocks was reclaimed, a good average considering the very bad condition of this street. On other contracts of a similar nature the percentage of old blocks used has averaged between 80 and 95 per cent.

Eliminating Railway Grade Crossings in Los Angeles

A report on the elimination of railway grade crossings in the city of Los Angeles has recently been presented to the Municipal Board of Public Utilities by Franklin D. Howell, the board's Chief Engineer. Besides the elimination of grade crossings, Los Angeles has other problems which press for solution. Among these are the rerouting of its street-car service to reduce congestion and increase speed and the delays in the operation of interurban cars within the city.

The steam railway grade-crossing problem is easier of solution in Los Angeles than in many other cities because all the steam railways enter and leave Los Angeles in the valley of the Los Angeles River. The city's industrial district is located adjacent to the railways in this valley and generally on the same level as the railway tracks. It will not be feasible, therefore, to change the general level of these railway tracks, and Mr. Howell proposes that the principal thoroughfares crossing them and the industrial district through which the railways run should be carried by overhead viaducts. These should be wide enough to provide for the street-car traffic as well as the vehicle traffic, and would thus greatly relieve the present congestion and prevent delays which now result from street railways crossing steam railway tracks at grade.

Mr. Howell has made plans for six of these viaducts to have a minimum of 22-ft. clearance over the railway track and 14-ft. clearance over streets, increased to 15½-ft. clearance over street-railway lines. In the construction of such viaducts he proposes a two-column bent with spans of 40 to 50 ft. In crossing railroad yards, however, he advises longer spans to reduce the number of columns that would be endangered by derailed rolling stock. A span of 93 ft. would clear six tracks. For crossing the Los Angeles River he proposes a double-deck structure.

Special problems arise from the operation of the Pacific Electric Ry. Co.'s interurban system. This company's heavy interurban cars, weighing 35 to 40 tons and geared for high speed, are at present running from the outskirts of the city to its center on the city street railway tracks. These interurban cars add to the congestion on the street railway line, while the delay in reaching the heart of the city seriously affects the efficiency of the interurban service. Mr. Howell therefore recommends that the interurban lines should operate on a private right-of-way and should be required to elevate or depress their tracks above or below the street surface throughout the congested districts.

Engineering Literature

Heat Engineering

REVIEWED BY H. E. LONGWELL*

HEAT ENGINEERING: A Textbook of Applied Thermodynamics for Engineers and Students in Technical Schools—By Arthur M. Greene, Jr., Professor of Mechanical Engineering, Russell Sage Foundation, Rensselaer Polytechnic Institute; Sometime Junior Dean, School of Engineering, University of Missouri. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiv + 462; 198 illustrations. $4, net.

Should one dissect an average textbook treating of any specific type of heat engine, he will find that if the gossipy historical chapters, and the chapters on thermodynamic theory, and the chapters that deal with pure machine design, only, and the chapters that are written from commercial catalogs with the aid of a pair of scissors and a paste-brush, were all eliminated, an imposing volume will generally shrink to a comparatively insignificant book.

Since the same thermodynamic theory applies equally to steam engines, steam turbines, gas engines and compressors for air and other fluids; and since the same phenomena of heat transmission are common to boilers, condensers, evaporators, intercoolers, heating coils, refrigerating coils, cold-storage rooms, etc., it is evident that if a textbook has competent chapters on these general underlying principles, it is possible, on this common foundation, to present an adequate discussion of all the principal specific types of apparatus in a series of additional chapters so brief that they might almost be called appendices.

This is what Professor Greene has done. Emulating Doctor Eliot, who accomplished the prodigious task of crowding all the essentials of the world's literature on a bookshelf five feet long, he has succeeded in compressing a very respectable library of works on heat engineering to such a degree that it has ample elbow room on a bookshelf only one and one-half inches long.

The book opens with a most excellent and comprehensive chapter on thermodynamics, which the author characterizes all too modestly as "an outline only of the thermodynamic theory." This is followed by a short chapter (10 pages) on Heat Engines and Efficiencies, explaining the methods of reporting the performance, and giving a number of examples in which the efficiencies of various types of engines are computed from the observed data. With the addition of Chapter III on Heat Transmission we have a substantial foundation for the study of all the various engineering structures which involve the principles discussed in these three introductory chapters.

Chapter IV deals with Air Compressors; Chapters V and VI, with Steam Engines, simple and multiple expansion; Chapter VII, with Steam Nozzles, Injectors and Steam Turbines; Chapter VIII, with Condensers, Cooling Towers and Evaporators; Chapter IX, with Internal Combustion Engines, and Chapter X, with Refrigeration.

From this brief résumé of the contents, it will be seen that the work covers very broadly the entire field of heat engineering. This breadth of scope, however, is not, as one might suspect, obtained by superficiality. The author has selected and condensed his material with rare good judgment, and has left unsaid practically nothing that any reasonable reader would regard as essential to a complete exposition of the subject.

The author has wisely refrained from entering into the matter of the physical construction of the several machines discussed, a subject that pertains purely to machine design and which has no logical place in a work of this sort. One who can deal ably with thermodynamic theory is not apt to discourse in a particularly illuminating manner on bearings, cylinders, flywheels, governors and other mechanical details of machines, and when expert machine designers attempt to expound thermodynamic theory, they are often more amusing than instructive.

Naturally in a work of this sort mathematics is very much in evidence, but it is handled in an unusually lucid manner. The reader will not be confused by typographical errors in the mathematical expressions, and the many numerical examples worked out in detail make the meaning and application of the formulas readily understandable.

A complete table of the symbols used in the text and a comprehensive index finish off a well planned and admirably executed work.

In addition to being an excellent textbook for students, the practicing engineer will find it an efficient and convenient instrument for polishing up his memory in spots that may have become rusty.

*General Manager, Westinghouse Air Spring Co., Smedley Building, New Haven, Conn.

Machinists' Handbook Revised

REVIEWED BY ROSSITER R. POTTER*

AMERICAN MACHINISTS' HANDBOOK and Dictionary of Shop Terms: A Reference Book of Machine Shop and Drawing-Room Data, Methods and Definitions—By Fred H. Colvin, M. Am. Soc. M. E., Associate Editor of the "American Machinist"; author of "Machine Shop Arithmetic," "Machine Shop Calculations," "American Machinists' Grinding Book," "The Hill Kink Books," etc., and Frank A. Stanley, M. Am. Soc. M. E., Associate Editor of the "American Machinist"; author of "Accurate Tool Work," "Automatic Screw Machines," "American Machinists' Grinding Book," "The Hill Kink Books," etc. Second edition, thoroughly revised and enlarged. New York and London: McGraw-Hill Book Co. Leather; 4x7 in.; pp. xxvi + 673; numerous illustrations. $3.

During the seven years since the publication of the first edition this book has become very generally accepted as the standard handbook for machinists, machine-shop foremen and superintendents. The second edition shows an increase of more than 25 per cent. (160 pages). Nearly one-third of this increase is comprised in additions to the sections on milling and milling cutters, and on horsepower, belts and shafting. Of the twenty pages added to the latter section, the greater part presents in tabular form unusually complete data on the power requirements of various machine tools under different conditions. In the section on milling, ten pages of the new material cover the Cincinnati Milling Machine Co.'s experiments, which have led to the development of a new form of tooth for milling cutters. It is of interest to note that the results of these tests have also led the authors

*Department Manager, Blood Brothers Machine Co., Allegan, Mich.

to reverse themselves in their explanation of the grade of finish obtained on milling-machine work. The major part of the new pages (chiefly tables) in this section is devoted to plain and differential indexing.

Some twenty-five pages are used to present six entirely new sections, as follows: Cold Saws; Turning and Boring; Oilstones and Their Uses; Broaches and Broaching; Steam Hammers and Drop Forgings; Knots, Eyebolts, Ropes and Chains. In the section on broaching, the S. A. E. standards are given for six and ten-splined holes. Many users of the book will wonder why the S. A. E. standards for square broached fittings were omitted. Other important additions are to the sections on Spiral Gears, eleven pages; Grinding and Lapping, twelve pages; Screw Machine Tools, six pages; Miscellaneous Tables, seven or eight pages, including dimensions and capacity tables for the leading types of modern ball bearings.

Noticeable effort has been made to improve the book in other ways besides the addition of new material. Most commendable perhaps of these improvements is the reduction to a more reasonable size of some of the simpler line cuts. The authors have succeeded in adding not a little to the convenience and value of the book. There is one careless error, in the use of an arithmetical sign, on p. 403, that has been carried over from the first edition. It is not a mistake that will be apt to cause much misunderstanding, but it sets a bad example to one class of users of the book and may diminish the respect of another class.

Engineering Economics

REVIEWED BY LEONARD METCALF*

ENGINEERING ECONOMICS; First Principles—By John Charles Lounsbury Fish, M. Am. Soc. C. E., Sometime Division Engineer Lake Shore & Michigan Southern Ry.; Professor of Railroad Engineering at Leland Stanford Junior University; author of "Earthwork Haul and Overhaul," etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xii + 217; illustrated. $2, net.

The author states that his "book is intended to meet the first needs of the student and to render effective service in the office," and that it was written "in the belief that to the engineer a working knowledge of first principles is as essential in the economics as in the mechanics of structures; and that special study and drill in the application of principles is as advantageous in the one case as in the other." The object of the author is a worthy one and the book gives evidence of careful study and thought.

The treatment appears to the reviewer didactic and unfortunate. A simple and more direct approach, reasoning from well-selected examples to principles, would seem likely to be more interesting to the student and to give point to the individual character of most economic engineering problems. Completeness of treatment in such problems is rarely to be obtained in practice, and the most reliable estimator is the one who has the keenest sense of the important elements in his problem, coupled with the most direct and simplest methods of approach to and solution of it. While it is desirable that the student should be instructed in the general methods of analysis and application of formulas, it is of far greater importance that he should develop a sense of perspective, be shown how to grasp the really important elements of his problem, and then work out in the simplest manner his analysis or formula indicating the influence of the various factors.

One of the greatest dangers in much of the cost estimating or valuation being done today lies in the failure to grasp and weigh the relative importance of the various factors involved, including hazard and the human problem, and in the failure to make proper allowance for the different conditions surrounding the different works, cost records of which have been obtained, and to compare the sum of the assembled individual cost sheets of different branches of the work with the final actual cost of the entire work. It is the failure to do this that has brought the estimates of so many engineers into disrepute, as unreliable in the opinion of bankers, owners and builders of such works. The author's failure to emphasize this side of the subject is unfortunate, as is the purely mathematical rather than constructive method of treatment adopted by him.

After a brief introduction, the elements of the problem of economic selection are treated, including simple and compound interest, sinking funds and annuities, first cost, and salvage value. In discussing the latter the term depreciation is given a significance totally at variance with accepted practice—depreciated value being defined as salvage value. Elements of yearly cost of service, amortization, interest and other fixed charges, operation, maintenance and outstanding data are then discussed. Next estimating is taken up. This includes general practice, effect of laws of error, and quantities of some particular types.

The solution of the problem of economic selection is then treated under four bases: Yearly cost of service, the capitalized cost of service, cost per unit of service, and capitalized cost per unit of service, per year. This is followed by methods of procedure for economic selection, with examples.

A fair bibliography, depreciation and life tables, and tables of formulas follow.

The book is disappointing from the point of view of the practicing engineer and might advantageously be simplified from that of the student, as it tends to bring into undue prominence formulas rather than methods and the relative importance of the elements of the problem.

AN INTRODUCTION TO TOWN PLANNING: A Handbook Dealing with the Principles of the Subject and a Consideration of the Problems Involved, Powers of Local Authorities, etc.—By Julian Julian, Borough Surveyor, Cambridge. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Co. Cloth; 5x8 in.; pp. vi + 149; illustrated. $1.75, net.

In contrast with most of the other books on town or city planning, this volume is small, handy, and contains but few illustrations—all line cuts.

After a brief but interesting review of the history of town planning the author takes up the powers of local authorities under the earlier by-laws and the 1909 Town Planning Act. He then considers some of the practical details of the preparation of town plans and passes on to "A Town Planning Tour," which consists of brief notes on salient features of the plans of a number of British and Continental cities. Appendixes deal with garden cities and suburbs, examples under the Town Planning Act of 1909, and extracts from Congressional resolutions, from the procedure schedule of the Town Planning Act and from a few books and papers on town planning.

*Consulting Engineer, 14 Beacon St., Boston, Mass.

As may be inferred, most of the space is devoted to British practice, which is exactly what many people this side the Atlantic would like to know about. The other matter in the book, however, is perhaps of more interest to Americans generally. The book is readable.

⌘

A Contractors' Textbook

THE ECONOMICS OF CONTRACTING: A Treatise for Contractors, Engineers, Manufacturers, Superintendents and Foremen Engaged in Engineering Contracting Work; Vol. II.—By Daniel J. Hauer, Construction Economist; Editor of "The Contractor." Chicago (Rand McNally Building): E. H. Baumgartner. Cloth; 6x9 in.; pp. 334; 27 illustrations. $2.50.

The earlier volume of this two-volume work (reviewed in *Engineering News,* Feb. 15, 1912, p. 325) laid down the principle that contracting had now become a profession and as such could be successfully discussed in a textbook. As was pointed out in the review of that first volume, however, contracting is primarily a business and one of the most complicated businesses in the world. Its principles, therefore, may be broadly outlined in any textbook, but the essentials of its practice are hardly reducible to words. In so far as it is possible to make such reduction, Mr. Hauer has succeeded admirably, but the fact remains that his two volumes are for the most part interesting and instructive reading for the present or prospective contractor rather than a *vade mecum* or handbook without which his business would suffer.

The second volume seems to have been conceived after the first was written, for there are many duplications of thought and hardly any strict differentiation of subject matter in the two volumes. This does not prevent the second part from having much that is new and interesting, because the subject is so broad that complete treatment could not be expected in one volume. The chapter headings of Volume II are as follows: Estimating and Bidding upon Contracts; Making Contracts and Obtaining Bonds; Financial End of Contracting; Preventing Law Suits; Planning Construction Jobs; Handling and Training Men; Office Filing Systems; Organization of a Construction Company; Lines of Contracting and Specialization and the Standing of Contractors. Generalizing broadly, it might be said that the chapters on office systems and financial organization will prove the most valuable part of the book and the sections devoted to the handling of men will be read with the most interest. Those chapters which attempt to outline methods of work could well have been omitted.

⌘

English Surveyors' Handbook

SURVEYING AND BUILDING CONSTRUCTION for Agricultural Students, Land Agents and Farmers—By A. H. Haines, Head of the Estate Management Department and Lecturer in Surveying at the South Eastern Agricultural College, Wye, Kent, England; Member of the Board of Studies in Agriculture of London University, and A. F. Hood Daniel, Lecturer in Building Construction at the South Eastern Agricultural College. New York and London: Longmans, Green & Co. Cloth; 6x9 in.; pp. xiii + 339; 222 illustrations. $3, net.

A typically English book. It combines subjects which are never associated in a single textbook in this country, and it contains many terms wholly unfamiliar to American engineers. Judging by the text, the work of an English surveyor includes farm building construction and a variety of things under farm management and the handling of estates which have never been grouped into a distinct profession on this side of the water.

The text is both elementary and practical. The first chapter on mensuration includes much elementary matter, tables, etc., usually to be had in our engineering pocketbooks. Rules are given for ascertaining the contents of ash heaps, the weight of cattle, the contents of dung heaps, of haystacks, cornstacks, etc.—information of a character which is rarely if ever found in American books.

It would seem that Gunter's chain (invented by Edmund Gunter in 1620) is still universally used for rural surveys. The steel tape, now so exclusively used for all survey work in this country, is in England used for land surveys "when very accurate measurements are required." Acres there are still divided into roods and perches.

Surveying equipment consists of ranging rods, poles, pickets, pegs or false pickets, offset poles, etc. Even the standard field notebook is different from ours, being 8 in. long by 4½ in. wide and opening on the end instead of on the side. The notes are not kept in the same manner either; the traverse is generally represented by a double line with station distances written between. Instrument station distances are inclosed in rings.

Surveying instruments, to judge from the illustrations, are of the type which was used in this country about 1850; at least some similar illustrations of levels and theodolites may be found in a Pike's catalog of surveying instruments published in New York in the fifties. These include a theodolite with high standards, with the vertical arc between the standards, such as few engineers in this country are old enough to remember having seen in use.

Under building construction is the usual collection of material on brick laying and masonry, carpentry and joinery, to be found in many of our American handbooks. There are a short chapter on hygiene (of the farm) and several pages of regulations of the local government board on dairy sanitation, farm water-supplies, drainage, etc. There is probably much of interest to American agricultural students in these parts of the book, although, as we have endeavored to show, there is little in the chapters on surveying that is common to American practice.

⌘

Tree and Shrub Field Book

FIELD BOOK OF AMERICAN TREES AND SHRUBS: A Concise Description of the Character and Color of Species Common Throughout the United States. Together with Maps Showing Their General Distribution—By F. Schuyler Mathews, author of "Field Book of American Wild Flowers," "Field Book of Wild Birds and Their Music," "Familiar Life of Field and Forest," Familiar Features of the Roadside." New York and London: G. P. Putnam's Sons. Cloth; 4x7 in.; pp. xvii + 465; profusely illustrated. $2, net.

Those who wish a small book to aid in the identification of the trees and shrubs of North America and to give some general information regarding their physical characteristics, industrial uses and geographical range will find this volume both useful and handy. The author states that he has given particular attention to the esthetic side of his subject, including color, form and proportion, and to scientific accuracy, particularly in his descriptive nomenclature.

The plan of the book is to give a general description of the tree or shrub under consideration, particulars of its bark, branching system, foliage, flowers and fruit, and then to state its geographical range and the character and value of its wood for timber purposes (if a tree). Pen sketches of two-thirds natural size show the leaves, flower and fruit of many of the trees and shrubs described in the text, and water-color and crayon sketches give general im-

pressions of the looks of typical specimen trees. Detail views of the bark of 18 trees serve as a key for the identification of trees by their bark. By similar ingenuity the distribution of trees and shrubs throughout the United States is shown by a series of 70 maps. Beneath each map are page references to the description of the several trees, the location of which is shown by it. A few other maps and diagrams add to the value and interest of the book. An index by common and botanical names completes the volume.

Electrical Engineers' Handbook

AMERICAN HANDBOOK FOR ELECTRICAL ENGINEERS: A Reference Book for Practicing Engineers and Students of Engineering—Compiled by a Staff of Specialists, Harold Pender, Editor-in-Chief; Professor of Electrical Engineering, University of Pennsylvania; formerly Director of Electrical Engineering Research Laboratory, Massachusetts Institute of Technology. New York: John Wiley & Sons, Inc. London: Chapman & Hall. Flexible leather; 4x7 in.; pp. xviii + 2023; illustrated. $5, net.

With at least two good handbooks for electrical engineers available, this one may be expected to show, and it does show, every evidence of careful and deliberate editing.

To many engineers, especially those dealing with the more practical application of electricity and electrical machinery, this volume will make a stronger appeal than some earlier ones because of the wide separation of theoretical discussion and practical description and the arrangement of relatively short notes in alphabetical order. To other engineers, particularly designers, the absence of logical grouping for sequence may prove disconcerting.

With the present arrangement a very good index is essential, since few persons would make the same alphabetical distribution of topics. A high degree of excellence has been secured in the index, though there still remain a few tortuous paths before some seekers will locate the information which they desire. For instance, one trail leads to "shunt wound—see name of apparatus," "dynamos—see generators and motors," and "generators, direct-current . . . . field winding, 671 . . . .," etc., before the reader rounds up the several items which may cover "shunt-wound dynamos." This may possibly be excused by the claim that no self-respecting electrical engineer would ever refer to "dynamos."

The scope of the handbook is very broad indeed, giving as it does—in addition to the principles and phenomena of electricity and magnetism, to all sorts of electrical instruments, apparatus, service equipment, practices and methods, and to closely related non-electrical matters—approximately 350 pages, or 18 per cent. of the whole text, on non-electrical matters of not very close relation. Such topics include the economic ideas of depreciation, interest and annuities; notes on general materials like timber, brick and concrete masonry, irons and steels, fuels, gases, acids and explosives, and also notes on mechanics and common machinery, simple structures, steam engineering and thermodynamics, hydraulics, dam construction, and waterwheels.

The book is so comprehensive in its purely electrical features that a detailed summary and criticism of its contents cannot here be attempted. It must suffice to state that a careful examination, coupled with a few weeks of desk reference, gives every indication of a comprehensive but concise treatment reasonably responding to a variety of demands for information. The general inclusion of cost data and a bibliography for each topic is sure to merit approval, even though the cost figures can give only a general idea of expense and the bibliographies reflect some personal preferences and lapses.

Study of a few sections will show the typical treatment of electrical subjects to be found throughout the book.

For instance, the chapter on "Primary Batteries" briefly but effectively passes over fields of service, theory of action and features of typical cells in five pages, while four pages are devoted to dry cells, their life, service, capacity, testing and cost (dry batteries have become of surprisingly great commercial importance).

"Storage Batteries" illustrates a more extended treatment of a subject. The theory and design of the alkaline (Edison) type are given in 2½ pages; performance features require about four pages; testing, one page; dimensions, weight, cost, etc., 1½ pages. The lead type of storage battery is similarly discussed in 17 pages. Applications of storage batteries in general are given in 16 pages.

The distribution of the component parts of a broad subject is well shown by "Electric Lighting." This is taken up under the separate topics of electric arc, arc lamps, incandescent lamps, distribution and transmission systems, laws of vision, laws of illumination, photometry, photometric quantities, street illumination and interior illumination. Under "Arcs" are brief notes on current through metallic-vapor streams, temperatures, luminosity, voltage-current relations, musical arcs, high-frequency oscillations caused by arcs, etc. Under "Arc Lamps" are such subtopics as voltage drops, increasing luminosity, commercial open and inclosed arcs (with tabulated performance data), flaming and magnetite arcs, regulating mechanisms, mercury-vapor lamps, and first and annual costs. Under "Incandescent Lamps" are short descriptions of incandescence phenomena, commercial carbon- and metal-filament types, typical performance data (which are already somewhat incomplete due to six months' advance in the development of certain tungsten lamps), cost of light, reflectors, etc. Under "Distribution and Transmission Systems" are found fairly complete notes on constant-current and constant-potential lines, direct and alternating systems, typical city circuits, efficiency, regulation, load balance, etc. "Laws of Illumination" covers the fundamental "inverse-square" and "cosine" laws for the propagation of light and illumination calculations. "Interior Illumination" describes direct, indirect and semi-indirect disposition of illuminants, quantity of light required for various arrangements, best location of lamps and maintenance. "Street Illumination" gives the requirements of various streets, types of lamps available, desirable spacings and suspension heights, and costs. Under "Photometry" is presented a review of laboratory practice in measuring candlepower and flux-distribution characteristics of illuminants. "Photometric Quantities" defines the terms involved. "Laws of Vision" includes a summary of the rod-cone theory, and of intensity, extensity, color and duration sensations. It summarizes data on amount of light flux needed for best vision.

ZEITSCHRIFTENSCHAU AUS DEM GEBIETE DES WASSERBAUES, Heft I: Im Auftrage des Ministerium der öffentlichen Arbeiten—Herausgegeben von Wilhelm Ernst & Sohn, Berlin, Germany. Paper; 11x14 in. Yearly price, 12 Marks.

An index, with abstracts, covering periodical literature in the field of hydraulic construction is something

new in the publishing world. This is its first issue, Heft I. We are not informed how often it is to appear, but the price of annual subscription is stated. The scheme of grouping is to place all the matter under about 110 heads. In each issue all the abstracts under "Sewerage," for example, are placed together, and occupy one or more quarter-page units, each headed by the words "Entwasserung von Städten (siehe auch Abwasser.)"

The arrangement is designed for clipping and filing. Each page is ruled into quarters $4\frac{7}{16}$x$6\frac{1}{8}$ in., treated as units which may be clipped out and filed in a card file of corresponding size. The paper is heavy, for this purpose, and the printing is on only one side.

⁂

BUILDING THE NEW RAPID-TRANSIT SYSTEM OF NEW YORK CITY—By Fred Lavis. From Personal Studies for "Engineering News," with Use of Official Data and Photographs of the Public Service Commission. (Containing also Design of the New Elevated-Railway Lines by Maurice E. Griest, Assistant Designing Engineer, Public Service Commission for the First District.) [Reprinted from "Engineering News."] New York and London: McGraw-Hill Book Co., Inc. Cloth; 9x12 in.; pp. 73; 99 illustrations. $1.50.

In presenting this collection of carefully prepared matter the publishers perform a creditable service in making generally available a comprehensive study of subway-building methods. Fred Lavis' observations of the way different contractors on the New York subways are handling their work are no doubt the better for being based on years of experience in construction. This is fortunate in view of the fact that no summary of the construction methods has been published by the Public Service Commission or by other competent source. Probably it will be some years before any such summary will be issued, if at all. Until then Lavis' account is the only thorough collection of data available.

Special mention is due M. E. Griest's complete statement of how the New York elevated-railway lines were designed. First-class structural-steel practice is represented in these lines, and careful analysis and reasoning were employed in fixing the details. Mr. Griest's monograph is a classic of the subject.

⁂

BUILDING CODE RECOMMENDED BY THE NATIONAL BOARD OF FIRE UNDEDWRITERS, NEW YORK: An Ordinance Providing for Fire Limits, and Regulations Governing the Construction, Alteration, Equipment, Repair, or Removal of Buildings or Structures. Fourth Edition, Revised. New York (76 William St.): National Board of Fire Underwriters. Linen; 5x8 in.; pp. 326; illustrations.

Nominally this is a revision (4th edition) of the "model" building code first prepared by the National Board of Fire Underwriters in 1905. In reality it is a completely new building code and may be described as one of the most progressive documents in this field which has come out in recent times. The structural and fire-protection elements of the code have been revised throughout. The question of incombustible roofings is treated quite carefully, and a test for degree of inflammability is given. Just as radical are the requirements for certificates of occupancy for buildings; for certain occupancies sprinklers are required. Drastic new provisions are made for fire escapes; ordinary iron balconies connected by ladders or steps are not regarded as fire escapes except under special circumstances. In general, horizontal exits, smokeproof towers and outside stairways are called for. Exits are proportioned according to the number of occupants instead of floor areas. The new Forest Service grading rules for timber are included, and load tables for timber beams are given, based on considerably higher fiber stresses than heretofore used, namely, 1600 and 1200 lb. per sq.in. for yellow pine of grades 1 and 2, 1500 lb. for Douglas fir, 1000 lb. for spruce or Norway pine, 1300 lb. for western hemlock, and 1400 lb. for oak.

The inclusion of full specifications for the use of hollow blocks in walls, without discrimination, may also be considered a progressive requirement.

Every one concerned with the administration, preparation or improvement of building codes needs the book, and all who contemplate building a house should study its provisions.

⁂

A useful classified reference list of books and articles on city planning has just been published by the Public Library, Riverside, Calif.

⁂

A pamphlet of rules and instructions for the guidance of applicants for the approval of plans for the repair, alteration and construction of dams has been prepared by the engineering department of the Water Supply Commission of Pennsylvania (Harrisburg). Specimen plans are shown.

⁂

A bulletin on "The Regulation of the Jitney Bus," by Andrew Linn Bostwick, Librarian, Municipal Reference Branch, has been issued by the St. Louis Public Library. It contains a useful digest of the municipal ordinances which have been enacted in some twenty-five cities of the United States where jitney busses have been extensively used.

⁂

A complete account of the construction of the new mechanical filtration plant at St. Louis, Mo., the largest of its type in the world, is contained in the Annual Report of the Water Commissioner of St. Louis for 1914-15, just received. The report contains much matter descriptive of the St. Louis water-works not generally found in a publication of this kind. There is also a bibliography of all publications, articles, etc., on the water-works from 1865 to 1914. A supplemental report on water-supply by Edward E. Wall, Water Commissioner, covers in detail the improvements authorized in 1912 and now practically completed, including the filter plant, which was described by Mr. Wall in *Engineering News* of Oct. 23, 1913. Other features of the new construction have also been described in the issues of Dec. 25, 1913, May 14, 1914, and Jan. 28, 1915.

⁂

There are now available for distribution the standard specifications adopted by the American Society of Municipal Improvements at Boston in 1914 for Sheet Asphalt Paving, Brick Paving, Creosoted Wood-Block Paving, Stone-Block Paving, Cement Concrete Paving, Broken Stone and Gravel Roads and Sewer Construction. The specifications for Bituminous Paving are not yet issued, but are kept waiting for a report of the committee on bituminous paving. George W. Tillson, Consulting Engineer of the Borough of Brooklyn, New York City, is Chairman of General Committee on Standard Specifications. The specifications are copyrighted but any municipality will be given the right to use them or any part of them upon application to the secretary of the society. The

separate specifications in pamphlet form are 25c. each and the complete set of eight may be had in a bound volume for $2. They may be obtained of Charles C. Brown, Secretary of the American Society of Municipal Improvements, 702 Wulsin Building, Indianapolis, Ind.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

GARDNER AIR-LIFT PUMPING: Condensed Suggestions for the Installation of an Air-Lift System of Water Pumping—Some Tables of Efficiency, also Some Descriptive Data of Various Standard Types of Gardner Air Compressors. Quincy, Ill.: The Gardner Governor Co. Paper; 6x9 in.; pp. 16.

A catalog which, besides describing the compressors of this manufacturing company, gives a very interesting and complete discussion of air-lift pumping. It describes several ways of piping the well for air lift and reviews the advantages of the system. One table gives pressure and amount of air required to raise water, and another one, the horsepower required to compress air.

THE COLORADO STATUTE INCH AND SOME MINER'S INCH MEASURING DEVICES—By V. M. Cone. Bulletin No. 207, based on the work done in the hydraulic laboratory at Fort Collins, Colorado, under a coöperative agreement between the Colorado Experiment Station and the Office of the Experiment Stations, United States Department of Agriculture. Fort Collins, Colo.: Colorado Experiment Station. Paper; 6x9 in.; pp. 16; illustrated.

FORESTRY IN RELATION TO CITY BUILDING: An Address by T. P. Lukens. Throop College Bulletin, July, 1915. Pasadena, Calif.: Throop College of Technology. Paper; 6x8 in.; pp. 34; illustrated.

The author urges reforestation and also fire control in forested areas. He states that the yield of the collecting area of the Pasadena water-supply has doubled since 1899 and attributes it to the absence of fires in that area—the last large fire having occurred in 1895, when at least 12 of the 20 sq.mi. of drainage area was burned over.

GUIDEBOOK OF THE WESTERN UNITED STATES—Washington, D. C.: Superintendent of Documents. Paper; 6x9 in.; illustrated.

Part A—The Northern Pacific Route, with a Side Trip to Yellowstone Park—By Marius R. Campbell and Others. Bulletin 611.

Part B—The Overland Route, with a Side Trip to Yellowstone Park—By Willis T. Lee, Ralph W. Stone, Hoyt S. Gale and Others. Bulletin 612.

Two other of these interesting and useful guidebooks will be published, covering the Santa Fé route and the Shasta route and Coast Line. Owing to the possible large demand and the limited number of copies available, those wishing the guidebooks must obtain them from the Superintendent of Public Documents, price $1 each.

WATER PURIFICATION PLANTS AND THEIR OPERATION—By Milton F. Stein, Assoc. M. Am. Soc. C. E., Assistant Engineer, Cleveland Filtration Plant. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. viii + 258; 95 illustrations, 11 charts. $2.50, net.

HISTORY OF THE PANAMA CANAL: Its Construction and Builders—By Ira E. Bennett. Associate Editors: John Hays Hammond, Patrick J. Lennox, B. A., Litt. D., William Joseph Showalter, Capt. Philip Andrews, U. S. N., Rupert Blue, M. D., D. P. H., J. Hampton Moore. Builders' Edition. Washington, D. C.: Historical Publishing Co. Cloth; 7x11 in.; pp. 583; illustrated. $5.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE: Proceedings of Annual Convention Held at Grand Rapids, Mich., Sept. 9-11, 1914. Chicago (608 City Hall): S. H. Viall, Secretary. Paper; 6x9 in.; pp. 79.

THE MANNHEIM (COMPLETE MANUAL) AND THE DUPLEX SLIDE RULES—By William Cox. Hoboken, N. J.: Keuffel & Esser Co. Paper; 6x9 in.; pp. 60; illustrated. 50c.

MODERN PLUMBING ILLUSTRATED: A Comprehensive and Thoroughly Practical Work on the Modern and Most Approved Methods of Plumbing Construction; the Standard Work for Plumbers, Architects, Builders, Property Owners, Boards of Health and Plumbing Examiners, and for Trade Classes in Plumbing—By R. M. Starbuck, Author of "Questions and Answers on the Practice and Theory of Sanitary Plumbing" (2 Vols.), "Questions and Answers on the Practice and Theory of Steam and Hot Water Heating," "Mechanical Drawing for Plumbers," etc. Third Edition Revised and Enlarged. New York: Norman W. Henley Publishing Co. Cloth; 8x11 in.; pp. 407; fully illustrated by 58 detailed plates made expressly by the author for this work. $4.

LEVEE AND DRAINAGE LAWS OF TEXAS: Bulletin No. 4—Austin, Texas: State Reclamation Department. Paper; 6x9 in.; pp. 89.

MASONRY AS APPLIED TO CIVIL ENGINEERING: Being a Practical Treatise on the Design and Construction of Engineering Works in Stone and Heavy Concrete—Adapted for the Use of Students and Those Engaged in the Practice of the Profession by F. Noel Taylor, author of "A Manual of Civil-Engineering Practice." New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xi + 230; 212 illustrations.

A MODEL HEALTH CODE FOR TEXAS CITIES—By Robert M. Jameson, Secretary of the Bureau of Municipal Research and Reference. Municipal Research Series No. 8. Austin, Texas: University of Texas. Paper; 6x9 in.; pp. 95.

MOTION OF LIQUIDS—By Lieut.-Col. R. De Villamil. New York: Spon & Chamberlain. London: E. & F. N. Spon, Ltd. Cloth; 6x9 in.; pp. xiv + 210; 86 illustrations and 30 tables. $2.50.

PRACTICAL MECHANICS AND ALLIED SUBJECTS—By Joseph W. L. Hale, Associate Professor of Engineering, the Pennsylvania State College, Detailed as Supervisor Apprentice Schools, Pennsylvania Lines East of Pittsburgh and Erie; Member of the National Association of Corporation Schools; Member of the National Society for the Promotion of Industrial Education; Associate Member of the American Institute of Electrical Engineers; Author of "Practical Applied Mathematics." New York and London: McGraw-Hill Book Co., Inc. Cloth; 5x7 in.; pp. 225; 201 illustrations and text figures. $1, net.

NATIONAL FIRE PROTECTION ASSOCIATION: Proceedings of Annual Meeting Held at New York City, May 11-13, 1915. Boston, Mass. (87 Milk St.): Franklin H. Wentworth, Secretary. Paper; 6x9 in.; pp. 497. For Members Only; $1 a copy.

PRACTICAL TRACK WORK—By Kenneth L. Van Auken. Chicago, Ill.: Railway Educational Press, 14 East Jackson Boulevard. Cloth; 5x8 in.; pp. 216; illustrated. $1.50.

THE PREPARATION OF FERTILIZER FROM MUNICIPAL WASTE—By J. W. Turrentine, Scientist in Soil Laboratory Investigations, Bureau of Soils. (From Yearbook of Department of Agriculture for 1914.) Washington, D. C.: Department of Agriculture. Paper; 6x9 in.; pp. 309.

THE PRINCIPLES AND PRACTICE OF LINEAR PERSPECTIVE, Developed Along Original Lines: Being a Practical Handbook for Architects, Civil and Mechanical Engineers, Art Designers, Engravers, and for Draughtsmen Engaged in All the Industrial Arts, Including a Self-Explanatory Linear Perspective Chart in Simplified Form—By Herman T. C. Kraus, C. E. Second Edition, Revised and Enlarged. New York: Norman W. Henley Publishing Co., 132 Nassau St. Cloth; 10x13 in.; pp. 53; 15 plates of practical examples. $2.50.

PUBLIC HEALTH IN SPRINGFIELD, ILLINOIS: A Survey by the Department of Surveys and Exhibits, Russell Sage Foundation—By Franz Schneider, Jr. New York: Department of Surveys and Exhibits, Russell Sage Foundation. Paper; 6x9 in.; pp. 159; illustrated. 25c.

Among other topics treated this report deals with water-supply, sewerage and sewage disposal, and typhoid fever. Among recommendations for the improvement of the health department of the city is the employment of a full-time health officer.

THE SLIDE RULE: A Practical Manual—By Charles N. Pickworth, Editor of "The Mechanical World"; author of "Logarithms for Beginners"; "The Indicator: Its Construction and Application"; "The Indicator Diagram: Its Analysis and Calculation." 13th Edition. New York: D. Van Nostrand Co. Manchester, England: Emmott & Co. Cloth; 5x8 in.; pp. 122; 37 illustrations. $1.

The preface states that the contents have been further extended so as to include descriptions of various new slide rules and calculators. A note on the extraction of fifth root, etc., has also been added.

PUBLIC SERVICE COMMISSION FOR THE FIRST DISTRICT OF THE STATE OF NEW YORK: Report for the Year Ending Dec. 31, 1913; Vol. II, Statistics of Transportation Companies. Report for the Year Ending Dec. 31, 1914; Vol. I, Report and Appendices A to D, Inclusive. Linen; 6x9 in.; pp. 861 and 813.

PUBLIC WORKS DEPARTMENT, MADRAS PRESIDENCY: Administration Report for the Year 1913-14. Part II, Irrigation. Madras, India: Irrigation Branch of the Department. Cardboard; 8x13 in.; pp. 283; illustrated. 4 shillings, 3 pence.

STANDARD HAND BOOK FOR ELECTRICAL ENGINEERS Prepared by a Staff of Specialists—Frank F. Fowle, S. B., Editor-in-Chief, Consulting Electrical Engineer, M. Am. I. E. E., Illuminating Engineering Society and National Electric Light Association. Fourth Edition, rewritten and greatly enlarged. New York and London: McGraw-Hill Book Co., Inc. Leather; 4x7 in.; pp. 1984; illustrated. $5, net.

PURCHASING: Its Economic Aspects and Proper Methods—By H. B. Twyford, Otis Elevator Co. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xvi + 236; 121 illustrations. $3, net.

THE THEORY AND PRACTICE OF ORE DRESSING—By Edward S. Wiard, S. B., Member, Min. and Met. Soc. of America. First Edition. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 426; 254 text illustrations. $4, net.

ULTRA-VIOLET RAYS: A List of References to Material in the New York Public Library—Compiled by William B. Behrens, Division of Technology. Paper; 7x10 in.; pp. 20.

RESEARCH WORK, METROPOLITAN WATER BOARD. Eleventh Report—By Dr. A. C. Houston, Director of Water Examination, Metropolitan Water Board. Together with Index to Research Reports, Nos. I-X, inclusive. London, England: Metropolitan Water Board (Savoy Court, Strand, W. C.). Paper; 8x13 in.; pp. 52 + vii. 2½ shillings.

The larger part of this report is devoted to an account of a continuation of Dr. Houston's experiments on the excess lime method of water treatment. Detailed chemical and bacterial results are given. The report also contains a "Note on 'Water Microbes,' Giving the Cholera Red Reaction on First Test."

Field and Office

Cost of Fence Wire, Wood and Steel Posts

The report of the Committee on Signs, Fences and Crossings, presented at the annual meeting of the American Railway Engineering Association, gives some interesting figures of cost for two sections of test fence on the Philadelphia division of the Baltimore & Ohio R.R. One section had metal posts and the other had wood posts. Each section, erected in May, 1913, was 4620 ft. long and had electrically welded wire fence of No. 9 galvanized wires. The figures given in the report are tabulated below:

	Steel Posts	Wood
Labor, driving and tamping intermediates	$0.0573	....
Setting end or anchor posts	1.22	....
Total	$1.2773	....
Digging holes, distributing and setting	....	$0.0879
Erecting fence on posts, per rod	.18	.1576
Erecting fence on posts, per mile	57.60	50.43
Stretching wire, per rod	.0613	.0672
Stretching wire, per mile	19.62	21.50
Posts, price	.245 (line)	.18
Posts, cost in place	.3023	.2679

Relaying Street-Railway Track at Cincinnati

The Cincinnati Traction Co. has been raising its grade slightly and replacing light rails with heavy rails for about two miles on Madison Ave., practically without interruption to its traffic. The city repaved this section of the street last year. The company was not able to relay its tracks at that time, and merely filled in its space, and in some instances roughly replaced the old asphaltic concrete paving. The new work this year was thereby facilitated, as it was easy to remove the filling and get at the rails.

The earth and stone around the rails were dug out with picks, so that the spikes and splices could be removed and the rails taken up and hauled away. The excavation to grade was about 19 in. deep (below the street surface), and was made by means of a Thew shovel, operated by current taken from the trolley wire. [illegible]

With this arrangement, and the mixer moving along slowly but continuously, 1020 lin.ft. of concrete base, 9½ ft. wide and 6 in. deep, was laid in one night on Vine St. On Madison Ave., however, the work was slower, as it was all done during daylight working hours, the principal interference being the operation of the cars. About 300 lin.ft. per day of work was a good average for the shovel, and about the same for the concreting.

The chief feature in the handling of the car traffic during the work was the use of a temporary third track, made up in 30-ft. sections, with steel ties, so that it could be laid or taken up rapidly. This was laid for a distance of several blocks, and advanced as the work progressed. It enabled the cars to be operated virtually without interruption, and at the same time allowed one track to be given over completely to the reconstruction work.

MADISON AVE. STREET RAILWAY RELAYING, CINCINNATI, OHIO

Upper View—General view, showing material in place and temporary car track. Lower View—Track concrete mixer working

Reducing Square Feet to Decimals of Acres

The accompanying table has been found valuable for readily and accurately determining the areas of small tracts of land. In making descriptions to be embodied in a deed after the area has been determined in square feet, the acreage can be obtained by reading directly from the table for areas between 0 and 1000 sq.ft. and by a single mental addition for areas between 1000 and 100,000 sq.ft. Thus for 665 sq.ft. follow down the column headed 600 to line opposite 60 and find 0.01515. In same column on line opposite 70 find 0.01538. So 665 sq.ft. equals 0.015+ acre. Again, suppose the area is 49,524 sq.ft. In column headed 500 on line 40,000 read 0.92975. In column headed 0 on line 20 read 0.00046 and on line 30 read 0.00069. Hence interpolating for 24 ft. and adding gives 0.930 acre as the area in the

[The "Millionaire" computing machine[1] is of Swiss manufacture and is claimed to be the only computing machine that operates on the multiplication principle. Only one turn of the crank is required for each figure in the multiplier or quotient, instead of one turn for each unit of each figure, as with machines which operate on the addition principle.—Editor.] A single shift of the carriage gives the value for 100 sq.ft. to be added each time in the part of the table commencing 1000 and the process of turning with left hand and setting down results with the right continues, excepting that we now go across the lines instead of running down the columns. After computing the values to 43,900 sq.ft., another shift in the carriage is made to give the value of 1000 sq.ft. each time, and the value of 40,000 sq.ft., already found, set in the sum column on the machine. Another shift at 100,000 for the value of 100,000 and the table is carried to completion with very little labor.—B. F. Sperow, Caro-

TABLE OF SQUARE FEET REDUCED TO DECIMALS OF AN ACRE

Feet	0	100	200	300	400	500	600	700	800	900
0	0.00000	0.00230	0.00459	0.00689	0.00918	0.01148	0.01377	0.01607	0.01837	0.02066
10	0.00023	0.00253	0.00482	0.00712	0.00941	0.0171	0.01400	0.01630	0.01859	0.02089
20	0.00046	0.00275	0.00505	0.00735	0.00964	0.01194	0.01423	0.01653	0.01882	0.02112
30	0.00069	0.00298	0.00528	0.00758	0.00987	0.01217	0.01446	0.01676	0.01905	0.02135
40	0.00092	0.00321	0.00551	0.00781	0.01010	0.01240	0.01469	0.01699	0.01928	0.02158
50	0.00115	0.00344	0.00574	0.00803	0.01033	0.01263	0.01492	0.01722	0.01951	0.02181
60	0.00138	0.00367	0.00597	0.00826	0.01056	0.01286	0.01515	0.01745	0.01974	0.02204
70	0.00161	0.00390	0.00620	0.00849	0.01079	0.01309	0.01538	0.01768	0.01997	0.02227
80	0.00184	0.00413	0.00643	0.00872	0.01102	0.01331	0.01561	0.01791	0.02020	0.02250
90	0.00207	0.00436	0.00666	0.00895	0.01125	0.01354	0.01584	0.01814	0.02043	0.02273
1,000	0.02296	0.02525	0.02755	0.02984	0.03214	0.03444	0.03673	0.03903	0.04132	0.04362
2,000	0.04591	0.04821	0.05050	0.05280	0.05510	0.05739	0.05969	0.06198	0.06428	0.06657
3,000	0.06887	0.07117	0.07346	0.07576	0.07805	0.08035	0.08264	0.08494	0.08724	0.08953
4,000	0.09183	0.09412	0.09642	0.09871	0.10101	0.10331	0.10560	0.10790	0.11019	0.11249
5,000	0.11478	0.11708	0.11938	0.12167	0.12397	0.12626	0.12856	0.13085	0.13315	0.13545
6,000	0.13774	0.14004	0.14233	0.14463	0.14692	0.14922	0.15151	0.15381	0.15611	0.15840
7,000	0.16070	0.16299	0.16529	0.16758	0.16988	0.17218	0.17447	0.17677	0.17906	0.18136
8,000	0.18365	0.18595	0.18825	0.19054	0.19284	0.19513	0.19743	0.19972	0.20202	0.20432
9,000	0.20661	0.20891	0.21120	0.21350	0.21579	0.21809	0.22039	0.22268	0.22498	0.22727
10,000	0.22957	0.23186	0.23416	0.23646	0.23875	0.24105	0.24334	0.24564	0.24793	0.25023
11,000	0.25252	0.25482	0.25712	0.25941	0.26171	0.26400	0.26630	0.26859	0.27089	0.27319
12,000	0.27548	0.27778	0.28007	0.28237	0.28466	0.28696	0.28926	0.29155	0.29385	0.29614
13,000	0.29844	0.30073	0.30303	0.30533	0.30762	0.30992	0.31221	0.31451	0.31680	0.31910
14,000	0.32140	0.32369	0.32599	0.32828	0.33058	0.33287	0.33517	0.33746	0.33976	0.34206
15,000	0.34435	0.34665	0.34894	0.35124	0.35353	0.35583	0.35813	0.36042	0.36272	0.36501
16,000	0.36731	0.36960	0.37190	0.37420	0.37649	0.37879	0.38108	0.38338	0.38567	0.38797
17,000	0.39027	0.39256	0.39486	0.39715	0.39945	0.40174	0.40404	0.40634	0.40863	0.41093
18,000	0.41322	0.41552	0.41781	0.42011	0.42241	0.42470	0.42700	0.42929	0.43159	0.43388
19,000	0.43618	0.43847	0.44077	0.44307	0.44536	0.44766	0.44995	0.45225	0.45454	0.45684
20,000	0.45914	0.46143	0.46373	0.46602	0.46832	0.47061	0.47291	0.47521	0.47750	0.47980
21,000	0.48209	0.48439	0.48668	0.48898	0.49128	0.49357	0.49587	0.49816	0.50046	0.50275
22,000	0.50505	0.50735	0.50964	0.51194	0.51423	0.51653	0.51882	0.52112	0.52342	0.52571
23,000	0.52801	0.53030	0.53260	0.53489	0.53719	0.53948	0.54178	0.54408	0.54637	0.54867
24,000	0.55096	0.55326	0.55555	0.55785	0.56015	0.56244	0.56474	0.56703	0.56933	0.57162
25,000	0.57392	0.57622	0.57851	0.58081	0.58310	0.58540	0.58769	0.58999	0.59229	0.59458
26,000	0.59688	0.59917	0.60147	0.60376	0.60606	0.60836	0.61065	0.61295	0.61524	0.61754
27,000	0.61983	0.62213	0.62242	0.62672	0.62902	0.63131	0.63361	0.63590	0.63820	0.64049
28,000	0.64279	0.64509	0.64738	0.64968	0.65197	0.65427	0.65656	0.65886	0.66116	0.66345
29,000	0.66575	0.66804	0.67034	0.67263	0.67493	0.67723	0.67952	0.68182	0.68411	0.68641
30,000	0.68870	0.69100	0.69330	0.69559	0.69789	0.70018	0.70248	0.70477	0.70707	0.70937
31,000	0.71166	0.71396	0.71625	0.71855	0.72084	0.72314	0.72543	0.72773	0.73003	0.73232
32,000	0.73462	0.73691	0.73921	0.74150	0.74380	0.74610	0.74839	0.75069	0.75298	0.75528
33,000	0.75757	0.75987	0.76217	0.76446	0.76676	0.76905	0.77135	0.77364	0.77594	0.77824
34,000	0.78053	0.78283	0.78512	0.78742	0.78971	0.79201	0.79431	0.79660	0.79890	0.80119
35,000	0.80349	0.80578	0.80808	0.81038	0.81267	0.81497	0.81726	0.81956	0.82185	0.82415
36,000	0.82644	0.82874	0.83104	0.83333	0.83563	0.83792	0.84022	0.84251	0.84481	0.84711
37,000	0.84940	0.85170	0.85399	0.85629	0.85858	0.86088	0.86318	0.86547	0.86777	0.87006
38,000	0.87236	0.87465	0.87695	0.87925	0.88154	0.88384	0.88613	0.88843	0.89072	0.89302
39,000	0.89532	0.89761	0.89991	0.90220	0.90450	0.90679	0.90909	0.91138	0.91368	0.91598
40,000	0.91827	0.92057	0.92286	0.92516	0.92745	0.92975	0.93205	0.93434	0.93664	0.93893
41,000	0.94123	0.94352	0.94582	0.94812	0.95041	0.95271	0.95500	0.95730	0.95959	0.96189
42,000	0.96419	0.96648	0.96878	0.97107	0.97337	0.97566	0.97796	0.98026	0.98255	0.98485
43,000	0.98714	0.98944	0.99173	0.99403	0.99633	0.99862	1.00092	1.00321	1.00551	1.00780
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000
40,000	0.91827	0.94123	0.96419	0.98714	1.01010	1.03306	1.05601	1.07897	1.10193	1.12488
50,000	1.14784	1.17080	1.19375	1.21671	1.23967	1.26262	1.28558	1.30854	1.33149	1.35445
60,000	1.37741	1.40036	1.42332	1.44628	1.46924	1.49219	1.51515	1.53811	1.56106	1.58402
70,000	1.60698	1.62994	1.65289	1.67585	1.69880	1.72176	1.74472	1.76767	1.79063	1.81359
80,000	1.83654	1.85950	1.88246	1.90541	1.92837	1.95133	1.97428	1.99724	2.02020	2.04316
90,000	2.06611	2.08907	2.11203	2.13498	2.15794	2.18090	2.20385	2.22681	24977	2.27272
100,000	2.29568	3.00000	4.00000	5.00000	6.00000	7.00000	8.00000	9.00000	10.00000	

Field and Office

Cost of Fence Wire, Wood and Steel Posts

The report of the Committee on Signs, Fences and Crossings, presented at the annual meeting of the American Railway Engineering Association, gives some interesting figures of cost for two sections of test fence on the Philadelphia division of the Baltimore & Ohio R.R. One section had metal posts and the other had wood posts. Each section, erected in May, 1913, was 4620 ft. long and had electrically welded wire fence of No. 9 galvanized wires. The figures given in the report are tabulated below:

	Steel Posts	Wood
Labor, driving and tamping intermediates	$0.0573	....
Setting end or anchor posts	1.22	....
Total	$1.2773	....
Digging holes, distributing and setting	....	$0.0879
Erecting fence on posts, per rod	.18	.1576
Erecting fence on posts, per mile	57.60	50.43
Stretching wire, per rod	.0613	.0672
Stretching wire, per mile	19.62	21.50
Posts, price	.245 (line)	.18
Posts, cost in place	.3023	.2679

Relaying Street-Railway Track at Cincinnati

The Cincinnati Traction Co. has been raising its grade slightly and replacing light rails with heavy rails for about two miles on Madison Ave., practically without interruption to its traffic. The city repaved this section of the street last year. The company was not able to relay its tracks at that time, and merely filled in its space, and in some instances roughly replaced the old asphaltic concrete paving. The new work this year was thereby facilitated, as it was easy to remove the filling and get at the rails.

The earth and stone around the rails were dug out with picks, so that the spikes and splices could be removed and the rails taken up and hauled away. The excavation to grade was about 19 in. deep (below the street surface), and was made by means of a Thew shovel, operated by current taken from the trolley wire. The ties were taken up by hand as the shovel reached them. The excavated material was carried off in wagons and largely used in filling for property owners in the vicinity, the ground being very uneven. Following the shovel work, a few men trimmed the rough edges of the excavation. The surface was then rolled in readiness for the ties, which were supported at the required elevation by means of blocking.

The concrete was mixed by a Foote mixer mounted on a truck and was delivered in place by a steel spout. The mix was 1:2:7, using sand and gravel. The cement was delivered in sacks and piled at intervals along the sidewalk. Sand (and in some cases gravel) was hauled by the company's work cars and dumped along one side of the work, while most of the gravel was hauled by wagons and dumped on the opposite side in a continuous pile. Water was taken from the city's fire-plugs and paid for according to the cubic yards of concrete placed.

With this arrangement, and the mixer moving along slowly but continuously, 1020 lin.ft. of concrete base, 9½ ft. wide and 6 in. deep, was laid in one night on Vine St. On Madison Ave., however, the work was slower, as it was all done during daylight working hours, the principal interference being the operation of the cars. About 300 lin.ft. per day of work was a good average for the shovel, and about the same for the concreting.

The chief feature in the handling of the car traffic during the work was the use of a temporary third track, made up in 30-ft. sections, with steel ties, so that it could be laid or taken up rapidly. This was laid for a

MADISON AVE. STREET RAILWAY RELAYING, CINCINNATI, OHIO

Upper View—General view, showing material in place and temporary car track. Lower View—Track concrete mixer working

distance of several blocks, and advanced as the work progressed. It enabled the cars to be operated virtually without interruption, and at the same time allowed one track to be given over completely to the reconstruction work.

At one point, however, where it was desired to improve a bad curve, both tracks had to be relaid together. Up to that point the work had been handled on the outside track, while both tracks here had to be moved inward several feet. Taking advantage of a few hours of free time at night and of the short intervals between the cars, the old tracks were taken up, the new ones laid, and the concreting went ahead under the cars. The concrete was tamped with picks to insure thorough filling under the ties.

The concrete is 9 in. thick and comes within 3 in. of the top of the ties. After this has set, the paving contractor places 6 in. of concrete (of the same mixture), which leaves just room enough for the granite paving blocks. The laying of these completes the job.

The work was under the direction of C. Henderson, Engineer for the company, with J. Hysam as Superintendent.

Reducing Square Feet to Decimals of Acres

The accompanying table has been found valuable for readily and accurately determining the areas of small tracts of land. In making descriptions to be embodied in a deed after the area has been determined in square feet, the acreage can be obtained by reading directly from the table for areas between 0 and 1000 sq.ft. and by a single mental addition for areas between 1000 and 100,000 sq.ft. Thus for 665 sq.ft. follow down the column headed 600 to line opposite 60 and find 0.01515. In same column on line opposite 70 find 0.01538. So 665 sq.ft. equals 0.015+ acre. Again, suppose the area is 49,524 sq.ft. In column headed 500 on line 40,000 read 0.92975. In column headed 0 on line 20 read 0.00046 and on line 30 read 0.00069. Hence interpolating for 24 ft. and adding gives 0.930 acre as the area to the nearest thousandth of an acre for 40,524 sq.ft. There is an interesting fact in connection with the making of this table, namely, the use of a computing machine, which can be used in a like manner to advantage in making any similar table. By starting in a column headed 0 and reading down to line 90, then beginning at the top of column headed 100 and reading down to line 90 and continuing reading in this way across the sheet to 990, it is observed that there is a regular increase of 10 sq.ft. each time. The value of 10 sq.ft. in acres is determined to the eighth figure beyond the decimal. This is placed in the "Millionaire" computing machine with the regulator set on addition and the multiplier lever set at 1. Then the crank is turned with the left hand and the results after each turn are set down with the right from 10 sq.ft. to 1000 sq.ft.

TABLE OF SQUARE FEET REDUCED TO DECIMALS OF AN ACRE

Feet	0	100	200	300	400	500	600	700	800	900
0	0.00000	0.00230	0.00459	0.00689	0.00918	0.01148	0.01377	0.01607	0.01837	0.02066
10	0.00023	0.00253	0.00482	0.00712	0.00941	0.0171	0.01400	0.01630	0.01859	0.02089
20	0.00046	0.00275	0.00505	0.00735	0.00964	0.01194	0.01423	0.01653	0.01882	0.02112
30	0.00069	0.00298	0.00528	0.00758	0.00987	0.01217	0.01446	0.01676	0.01905	0.02135
40	0.00092	0.00321	0.00551	0.00781	0.01010	0.01240	0.01469	0.01699	0.01928	0.02158
50	0.00115	0.00344	0.00574	0.00803	0.01033	0.01263	0.01492	0.01722	0.01951	0.02181
60	0.00138	0.00367	0.00597	0.00826	0.01056	0.01286	0.01515	0.01745	0.01974	0.02204
70	0.00161	0.00390	0.00620	0.00849	0.01079	0.01309	0.01538	0.01768	0.01997	0.02227
80	0.00184	0.00413	0.00643	0.00872	0.01102	0.01331	0.01561	0.01791	0.02020	0.02250
90	0.00207	0.00436	0.00666	0.00895	0.01125	0.01354	0.01584	0.01814	0.02043	0.02273
1,000	0.02296	0.02525	0.02755	0.02984	0.03214	0.03444	0.03673	0.03903	0.04132	0.04362
2,000	0.04591	0.04821	0.05050	0.05280	0.05510	0.05739	0.05969	0.06198	0.06428	0.06657
3,000	0.06887	0.07117	0.07346	0.07576	0.07805	0.08035	0.08264	0.08494	0.08724	0.08953
4,000	0.09183	0.09412	0.09642	0.09871	0.10101	0.10331	0.10560	0.10790	0.11019	0.11249
5,000	0.11478	0.11708	0.11938	0.12167	0.12397	0.12626	0.12856	0.13085	0.13315	0.13545
6,000	0.13774	0.14004	0.14233	0.14463	0.14692	0.14922	0.15151	0.15381	0.15611	0.15840
7,000	0.16070	0.16299	0.16529	0.16758	0.16988	0.17218	0.17447	0.17677	0.17906	0.18136
8,000	0.18365	0.18595	0.18825	0.19054	0.19284	0.19513	0.19743	0.19972	0.20202	0.20432
9,000	0.20661	0.20891	0.21120	0.21350	0.21579	0.21809	0.22039	0.22268	0.22498	0.22727
10,000	0.22957	0.23186	0.23416	0.23646	0.23875	0.24105	0.24334	0.24564	0.24793	0.25023
11,000	0.25252	0.25482	0.25712	0.25941	0.26171	0.26400	0.26630	0.26859	0.27089	0.27319
12,000	0.27548	0.27778	0.28007	0.28237	0.28466	0.28696	0.28926	0.29155	0.29385	0.29614
13,000	0.29844	0.30073	0.30303	0.30533	0.30762	0.30992	0.31221	0.31451	0.31680	0.31910
14,000	0.32140	0.32369	0.32599	0.32828	0.33058	0.33287	0.33517	0.33746	0.33976	0.34206
15,000	0.34435	0.34665	0.34894	0.35124	0.35353	0.35583	0.35813	0.36042	0.36272	0.36501
16,000	0.36731	0.36960	0.37190	0.37420	0.37649	0.37879	0.38108	0.38338	0.38567	0.38797
17,000	0.39027	0.39256	0.39486	0.39715	0.39945	0.40174	0.40404	0.40634	0.40863	0.41093
18,000	0.41322	0.41552	0.41781	0.42011	0.42241	0.42470	0.42700	0.42929	0.43159	0.43388
19,000	0.43618	0.43847	0.44077	0.44307	0.44536	0.44766	0.44995	0.45225	0.45454	0.45684
20,000	0.45914	0.46143	0.46373	0.46602	0.46832	0.47061	0.47291	0.47521	0.47750	0.47980
21,000	0.48209	0.48439	0.48668	0.48898	0.49128	0.49357	0.49587	0.49816	0.50046	0.50275
22,000	0.50505	0.50735	0.50964	0.51194	0.51423	0.51653	0.51882	0.52112	0.52342	0.52571
23,000	0.52801	0.53030	0.53260	0.53489	0.53719	0.53948	0.54178	0.54408	0.54637	0.54867
24,000	0.55096	0.55326	0.55555	0.55785	0.56015	0.56244	0.56474	0.56703	0.56933	0.57162
25,000	0.57392	0.57622	0.57851	0.58081	0.58310	0.58540	0.58769	0.58999	0.59229	0.59458
26,000	0.59688	0.59917	0.60147	0.60376	0.60606	0.60836	0.61065	0.61295	0.61524	0.61754
27,000	0.61983	0.62213	0.62242	0.62672	0.62902	0.63131	0.63361	0.63590	0.63820	0.64049
28,000	0.64279	0.64509	0.64738	0.64968	0.65197	0.65427	0.65656	0.65886	0.66116	0.66345
29,000	0.66575	0.66804	0.67034	0.67263	0.67493	0.67723	0.67952	0.68182	0.68411	0.68641
30,000	0.68870	0.69100	0.69330	0.69559	0.69789	0.70018	0.70248	0.70477	0.70707	0.70937
31,000	0.71166	0.71396	0.71625	0.71855	0.72084	0.72314	0.72543	0.72773	0.73003	0.73232
32,000	0.73462	0.73691	0.73921	0.74150	0.74380	0.74610	0.74839	0.75069	0.75298	0.75528
33,000	0.75757	0.75987	0.76217	0.76446	0.76676	0.76905	0.77135	0.77364	0.77594	0.77824
34,000	0.78053	0.78283	0.78512	0.78742	0.78971	0.79201	0.79431	0.79660	0.79890	0.80119
35,000	0.80349	0.80578	0.80808	0.81038	0.81267	0.81497	0.81726	0.81596	0.82185	0.82415
36,000	0.82644	0.82874	0.83104	0.83333	0.83563	0.83792	0.84022	0.84251	0.84481	0.84711
37,000	0.84940	0.85170	0.85399	0.85629	0.85858	0.86088	0.86318	0.86547	0.86777	0.87006
38,000	0.87236	0.87465	0.87695	0.87925	0.88154	0.88384	0.88613	0.88843	0.89072	0.89302
39,000	0.89532	0.89761	0.89991	0.90220	0.90450	0.90679	0.90909	0.91138	0.91368	0.91598
40,000	0.91827	0.92057	0.92286	0.92516	0.92745	0.92975	0.93205	0.93434	0.93664	0.93893
41,000	0.94123	0.94352	0.94582	0.94812	0.95041	0.95271	0.95500	0.95730	0.95959	0.96189
42,000	0.96419	0.96648	0.96878	0.97107	0.97337	0.97566	0.97796	0.98206	0.98255	0.98485
43,000	0.98714	0.98944	0.99173	0.99403	0.99633	0.99862	1.00092	1.00321	1.00551	1.00780

	0	1000	2000	3000	4000	5000	6000	7000	8000	9000
40,000	0.91827	0.94123	0.96419	0.98714	1.01010	1.03306	1.05601	1.07897	1.10193	1.12488
50,000	1.14784	1.17080	1.19375	1.21671	1.23967	1.26262	1.28558	1.30854	1.33149	1.35445
60,000	1.37741	1.40036	1.42332	1.44628	1.46924	1.49219	1.51515	1.53811	1.56106	1.58402
70,000	1.60698	1.62993	1.65289	1.67585	1.69880	1.72176	1.74472	1.76767	1.79063	1.81359
80,000	1.83654	1.85950	1.88246	1.90541	1.92837	1.95133	1.97428	1.99724	2.02020	2.04316
90,000	2.06611	2.08907	2.11203	2.13498	2.15794	2.18090	2.20385	2.22681	.24977	2.27272

100,000	2.00000	3.00000	4.00000	5.00000	6.00000	7.00000	8.00000	9.00000	10.00000	
2.29568	4.59136	6.88704	9.18272	11.47840	13.77408	16.06976	18.36544	20.66112	22.95680	

[The "Millionaire" computing machine[1] is of Swiss manufacture and is claimed to be the only computing machine that operates on the multiplication principle. Only one turn of the crank is required for each figure in the multiplier or quotient, instead of one turn for each unit of each figure, as with machines which operate on the addition principle.—Editor.] A single shift of the carriage gives the value for 100 sq.ft. to be added each time in the part of the table commencing 1000 and the process of turning with left hand and setting down results with the right continues, excepting that we now go across the lines instead of running down the columns. After computing the values to 43,900 sq.ft., another shift in the carriage is made to give the value of 1000 sq.ft. each time, and the value of 40,000 sq.ft., already found, set in the sum column on the machine. Another shift at 100,000 for the value of 100,000 and the table is carried to completion with very little labor.—B. F. Sperow, Carolina, Clinchfield & Ohio Ry., Johnson City, Tenn.

[The above indicates one of the many uses that may be made of a computing machine in engineering offices. Apparently because of their high cost, engineers have been reluctant to adopt mechanical devices for those tiresome and routine computations which have been the bane of many a man's practice. For computations in banking and insurance offices mechanical computers are now used exclusively. An article descriptive of other computing machines and their use for survey work was published in *Engineering News*, Jan. 7, 1915.—Editor.]

[1]Made by Hans W. Egli, Zurich, Switzerland, and handled in America by W. A. Morschhauser, 1 Madison Ave., New York City.

Retracing Old Compound Railway Curves

By F. W. Green*

In retracing old railway curves, it is sometimes found that the original notes and chaining show considerable discrepancies. When compound curves are to be re-established any discrepancy in the chaining is likely to cause inconvenience. In such cases, when the notes show the degree of curve for each branch, it is a simple matter to locate the P.C. and P.T., and then to chain the distance

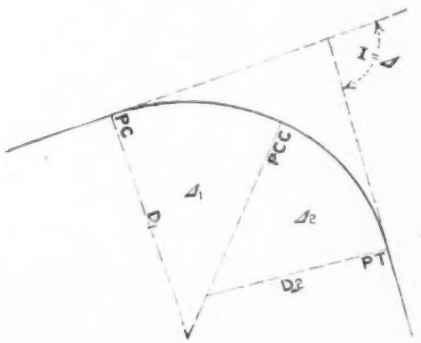


DIAGRAM OF COMPOUND CURVE TO BE RETRACED

from P.C. to P.T. The P.C.C. may then readily be located by the following method, which, so far as I can learn, is original:

(1) Given a compound curve (as in the accompanying plan), the intersection angle I, the location of P.C. and P.T., and degrees of curves D_1 and D_2; to find the station of the P.C.C. Let L_1 be the length of first curve, in stations; L_2 the length of second curve, and L the length of both curves. And let $I = \Delta$. Then:

$$\frac{\Delta - \Delta_2}{D_1} + \frac{\Delta_2}{D_2} = L.$$

Example: P.C. at Sta. 5502 + 00, $D_1 = 1°$, $D_2 = 2°$
$L = 27.37$, $\Delta = 38° 15'$

$$\frac{38.25 - \Delta_2}{1} + \frac{\Delta_2}{2} = 27.37$$

Whence: $\Delta_2 = 21.76° = 21° 45.6'$

$$L_2 = \frac{21.75}{2} = 10.88$$

$L - L_2 = L_1 = 27.37 - 10.88 = 16.49.$

Sta. of P.C. = 5502 + 00
Add L_1 = 16 + 49
Sta. of P.C.C. = 5518 + 49
Add L_2 = 10 + 88
Sta. of P.T. = 5529 + 37

(2) Given Δ_2 and Δ; D_1 and L; to find D_2

Transposing (1); $$D_2 = \frac{\Delta_2}{L - \frac{\Delta - \Delta_2}{D_1}}$$

Example: $\Delta_2 = 21.76$, $L = 27.37$, $\Delta = 38.25$; $D_1 = 1°$

$$D_2 = \frac{21.76}{27.37 - \frac{38.25 - 21.76}{1}} = 2°$$

Installing a Half-Mile Sewer System; Gilbert, Minn.

In the spring of 1915 the village of Gilbert, Minn., built about 3000 ft. of 8-in. pipe sewers in a recently annexed territory. The attached cost analysis shows how cheaply this work was done by municipal day labor. The rates of wages paid for an 8-hr. day were: Common labor, $2.25; teams, $5.50; masons, $6.40; pipe layer, $2.75. The average cost per linear foot of sewer completed, including manholes, was $1.50.

The sewer main to which these new sewers were to be connected was at a depth of 7½ ft. At the junction, a hole 7 ft. in diameter was dug uncovering about 4 ft. of the pipe. A manhole was then built over the pipe with the 8-in. pipe connection for the new sewer through the wall. The main sewer was then broken and the concrete invert through the manhole completed. The trench for the new sewer was started at the manhole, and as fast as the excavation was brought to grade, the pipe was laid and used to drain off any water which came into the trench.

COSTS, GILBERT, MINN., SEWERS
Started May 1, 1915, Finished June 14, 1915

Line A, 885 ft. in Length	
Excavation	$675.00
4 manholes	216.24
8-in. pipe and Y's	160.59
Filling trench	175.26
Teams and cement	33.55
Labor for laying pipe	43.00
Engineering and foreman	105.00
Total cost for line	$1408.64
Line C, 1037 ft. in Length	
Excavation	$747.00
5 manholes	283.59
8-in. pipe and Y's	201.94
Filling trench	194.00
Teams and cement	65.45
Labor for laying pipe	50.00
Engineering and foreman	80.00
	35.00
Total cost for line	$1656.98
Line E, 1053 ft. in Length	
Excavation	$488.48
3 manholes	124.87
8-in. pipe and Y's	200.07
Filling trench	146.25
Teams and cement	31.05
Labor for laying pipe	40.00
Engineering and foreman	70.00
Total cost for line	$1100.72
12 manholes cost $624.67. Average cost per manhole $52.05.	
Approx. 2479 cu.yd. earth, $1910.48. Average of 77c. per cu.yd.	
2479 cu.yd. filling, $515.51. Average of 20c. per cu.yd. (hand filling).	
2975 ft. of pipe laid for $133.00. Average of 0.0475c. per lin.ft.	
8-in. tile sewer pipe @ 18¾c. per lin.ft. Sand-lime bricks @ $12 per M.	
Line A, total cost	$1408.64
Line C, total cost	1656.98
Line E, total cost	1100.72
Total cost of system	$4166.34
Cost of lumber	72.05

In one of the trenches quicksand of the worst sort was encountered, and the ditch could not be kept open five minutes with the ordinary bracing. After trying many methods the following one succeeded: Iron rods, 2 in. in diameter, about 10 ft. long, were driven at intervals of 5 ft. Pieces of 2-in. plank 24 ft. long were laid horizontally, behind the rods, and between the planking and the sand hay and green boughs were wedged as tightly as possible.

White sand-lime brick costing $12 per M were used for building the manholes. Instead of using the ordinary tile stoppers for the Y's, galvanized-iron covers were put

in. When the Y's were ready to be opened and connected to the house drains, a hook was stuck into the cover and it came out easily. Tile covers have to be broken, and the chances are that part of the cover goes into the pipe. The 8-in. tile pipe cost 18¾c. per lin.ft., and the Y's, 6x8 in., cost 75c. each.—A Cohn, Gilbert, Minn.

Steam Shovel Burrows Its Way Out of Cut

The accompanying photographs, taken May 3, illustrate resourcefulness in operating a steam shovel. The shovel shown herewith was used in making the second cut in

FIGS. 1 AND 2. VIEWS OF STEAM SHOVEL DIGGING ITS WAY OUT OF CUT

Fig. 1—Timbering of second cut shown in rear. Fig. 2—Shovel nearing the completed tubes of Long Island R.R., in East New York. Observe character of side slopes in both views

a section of the grade-crossing elimination work which the Long Island R.R. has had under way for the last three years in East New York.

When this section of the second cut had been finished, the disposition of the shovel presented something of a problem. It would not do to lift it out of the cut, because the slopes might slide, nor could it be backed out by the way it had entered, because of the timbering shown in the rear, Fig. 1.

The four tubes of the tunnel had been completed to a point where the second cut on this section began. It was decided that the simplest way of moving the shovel to the surface was to have it dig its way down to one of the concrete tubes, the floor of which was 22 ft. below the floor of the second cut, and then to run the shovel out to the portal on the track laid inside the tube.

The spoil handled by the shovel was lifted out of the cut by a crane equipped with a bucket. In order to keep the water distributed uniformly in the boiler and the fire burning properly, the rear truck of the shovel was removed and the shovel was skidded on timbers down an 18-per cent. grade. Walter H. Gahagan, the contractor, states that the entire operation was performed without any particular difficulty.

Erection of Steel Arch Span, Detroit-Superior Viaduct

Cantilever erection of the 591-ft. steel arch forming the main span of the new Detroit-Superior viaduct in Cleveland is being carried on with unusually simple plant for so large a span. The principal work will be done by a timber top-chord traveler carrying two 25-ton stiff-leg derricks which were previously used on the ground in setting anchorage steel. The total weight of the traveler with derricks and hoisting engines is only about 70 tons. The hoists are 52-hp. electric machines built by the Thomas Elevator Co., Chicago. They have a pulling capacity of from 7500 to 8000 lb.

The traveler rolls on a track made of two 8x16-in. timbers laid flat side by side, resting on 8x8-in. by 3½-ft. ties laid on the top chord. In the three end panels of the arch the track is above the chord (being started on a flatter slope than the end sections of the top chord), and the track stringers rest on short falsework bents set on the chord. Beyond this portion of the track the traveler carriage follows the changing slope of the top chord, but the derricks are kept vertical by an adjustable link connecting a shoe at the rear end of the fore-and-aft leg to the back of the carriage (see Fig. 1).

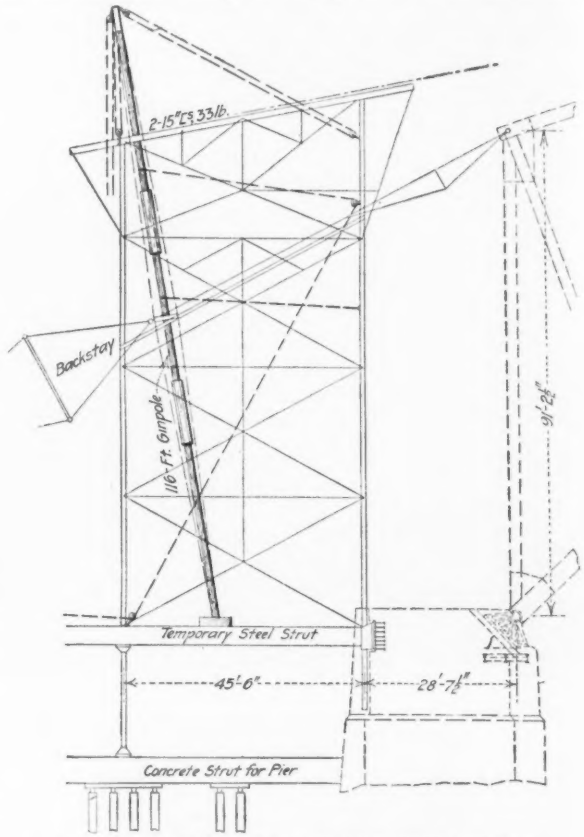


FIG. 2. GIN-POLE USED IN ERECTING TOWER

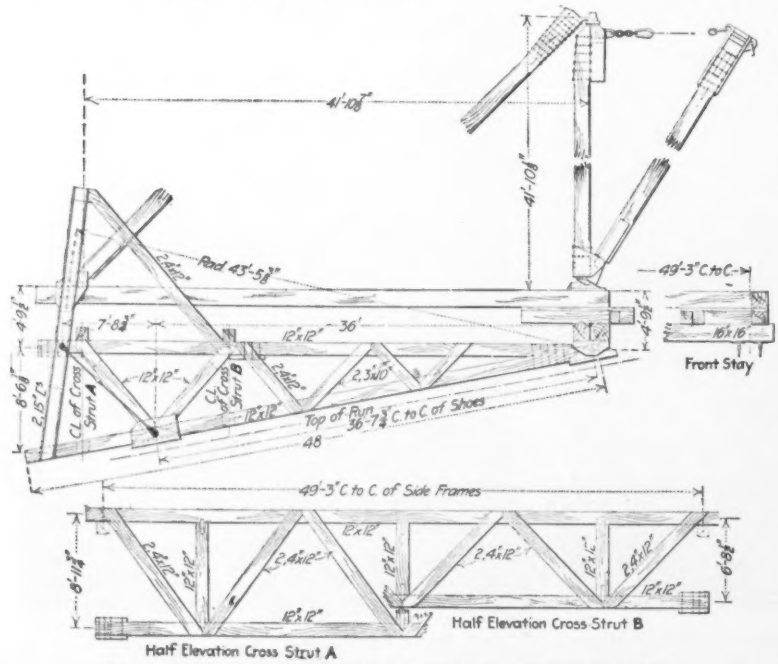


FIG. 1. ERECTION TRAVELER, DETROIT-SUPERIOR ARCH

The capacity of either derrick is sufficient to lift the heaviest member other than the lower-chord end section. Most of the material will be hoisted from scows in the river direct to place in the arch. Working forward from both piers to junction in the middle, the travelers will erect only the arches and their bracing. Then returning, they will placethe floor steel—two decks, the whole viaduct being a double-deck structure.

The eyebar backstays which hold the half-arches in place until joined at the center are remarkable for the shape of the toggle, which has least depth at the screw, so as to put the screw in tension.[1]

[1]See sketch in "Engineering News," of June 18, 1914, p. 1348, where drawings and details of the bridge are also given.

To carry the weight of backstay and toggle, and to support the traveler at the start, a steel erection tower has been built behind the main pier, on each bank. These towers were erected by a gin-pole. As the towers are about 90 ft. high, a 116-ft. gin-pole was built, shown in sketch Fig. 2. It was made of three lengths of 12x12, spliced at both joints by four 12-ft. pieces of 4x12, bolted through, and was stayed by four hog-rods made of 5/8-in. wire rope with turnbuckle connection at the bottom to a 1-in. rod. Four sets of double-part 1-in. guy lines extended back to blocks hitched to the tower, and led down the pole to a fastening at the foot. The pole was further steadied by a belly-guy near the upper quarter-point, leading through a snatch-block on the tower to a spool on the engine so that a strain could be held on it; and by a pair of slack guys lower down, near the middle of the length, hitched to two posts of the tower back of the pole.

This gin-pole was first set by a derrick at the lowest falsework level, to erect the lower part of the tower; later it was lifted to the level of the pier top, and in this position erected the upper part of the tower and the traveler carriage; it was then hoisted another story, to lift the first derrick to place. After the pole erected the east tower it was dismantled and reërected on the west bank (Fig. 4).

In erecting the first arch steel the backstays can not be used because they connect to the end pin of the top chord, which pin can be driven only after the entire first panel is in place. The first panel is therefore being set on falsework comprising a framed bent of 12x12's, set on the ground to support the lower chord just back of the first panel-point.

The first panel includes the heaviest member of the arch—the 30-ton end section of the lower chord. As

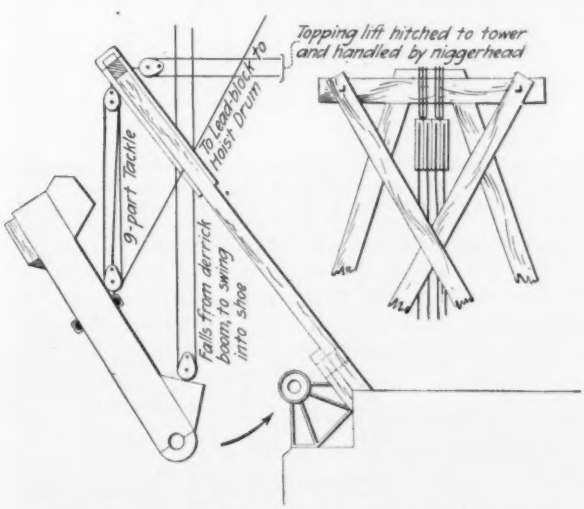

Topping lift hitched to tower and handled by niggerhead
To Lead-block
Hoist Drum
9-part Tackle
Falls from derrick boom, to swing into shoe

FIG. 3. SETTING OF SHEER-LEGS FOR HOISTING 30-TON CHORD

the traveler derricks could not safely lift this from their position on the forward overhang of the erection tower (Fig. 2), a pair of sheer-legs was set on the front edge of the pier, as shown by Fig. 3. With a 9-part hoisting tackle, this handles the weight of the chord-section from the ground; the derrick-falls then swing the L0 point to seat in the shoe.

FIG. 4. GIN-POLE 116 FT. HIGH, ERECTING WEST TRAVELER TOWER

Lower story of tower is concealed by pier 2. The gin-pole is stepped at the level of the bottom of the lower story

The arch panels are about 25 ft. long (24 panels = 591 ft.). The traveler will have to make a maximum reach of about 32 ft. in lifting steel from scows. The heaviest member it must handle is the 23½-ton post U2 L2.

The Ferro Construction Co., of Chicago, is erecting the arch; F. C. Fisher, President, designed the erection appliances. Both the arch steel and the traveler tower were fabricated by the King Bridge Co., of Cleveland. F. F. Buck, superintendent of erection, is in charge of the field work for the Ferro Construction Co. The first steel of the main arch was set July 29, as noted in the news pages of *Engineering News* of Aug. 5, 1915. It is expected that the arch will be closed by October, and the floor put in place by the end of the year.

Beaching a Vessel at High Tide for repairs to the hull is very common practice in the case of small vessels, and has been resorted to at the Pacific end of the Panama Canal for even such large vessels as the seagoing suction dredge "Culebra." As the range of tidal levels at the Pacific end is 20 to 21 ft., a vessel beached at high tide on the broad, sloping, sandy beach will be left high and dry at low tide. This method has been so successful with large-size vessels that, although a dry dock is now available at Panama, the "Culebra" was recently beached for minor exterior repairs to her hull because the work could be done in that way more cheaply and quickly than by drydocking.

Handling 62-Ton Concrete Blocks at Halifax

In the construction of the new Ocean Terminals for the Canadian Government Railways at Halifax, N. S., the quay walls are being formed of huge concrete blocks, most of which are 22x31 ft. in plan and 4 ft. thick. These are cast with a number of vertical openings and laid in place in the quay wall one on top of the other. The openings are matched and later filled with concrete so as to form a continuous solid wall 31 ft. wide.

For handling these blocks, the largest of which weigh 62 tons each, the crane shown in the accompanying view is being used. This is a regular "160-ton wrecking crane," made by the Industrial Works, of Bay City, Mich., equipped with a lattice boom instead of the ordinary crane arm. It was designed to handle a load of 70½ tons at approximately 33 ft. radius. As is shown in the view, the handling is facilitated by the use of a fairly compli-

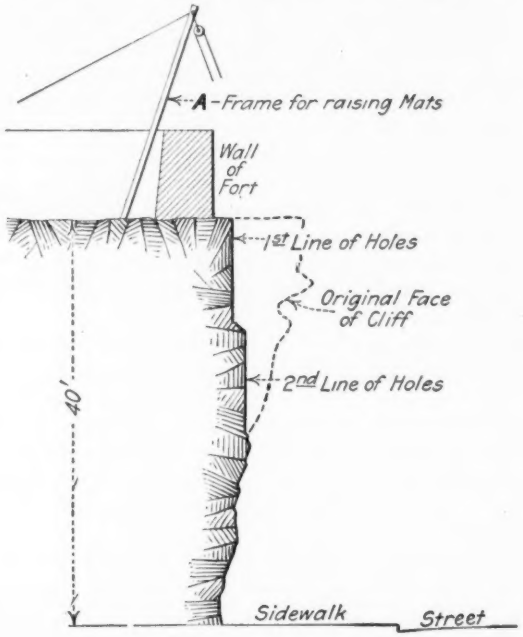
A TRACK CRANE LIFTING A 60-TON CONCRETE BLOCK AT HALIFAX TERMINAL

cated sling made of a structural frame provided with hooks controlled by a toggle-lift.

The work is in charge of James McGregor, Superintending Engineer for the Halifax Ocean Terminals, and is being executed by Foley Bros., Welch Stewart & Farquier, for whom L. G. Fuller is Superintendent.

NOTES

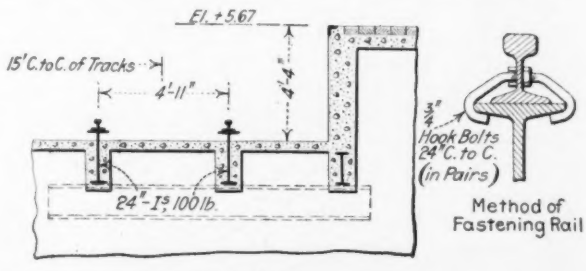
Facing-Off an Overhanging Cliff—Trimming a jagged cliff on which is perched Fort Horn, a relic of the days when the Indians threatened Manhattan Island, was a problem undertaken recently by the Degnon Contracting Co. for the Parks Department of New York City. About 25 years ago 123rd St. was cut through to the general level of the region north of Morningside Heights and as a result, Fort Horn, which consists of three rubble stone walls about 7 ft. high and 5 ft. thick built around three sides of a 30-ft. square, was left perched on the edge of a 40-ft. cliff. Deep holes and heavy charges of explosive had been used, and the rock in the upper part was badly shattered, so that later it began to crumble and pieces continued to slip down on the sidewalk below. To face off this cliff and eliminate the danger from falling fragments a line of 8-ft. holes on 4-in. centers was drilled the length of the dangerous portion (about 60 ft.), 18 in. out from the wall of the fort. A second row of holes was then drilled, starting at the foot of the first line, as shown in the accompanying sketch. After the bulk had been shot away, the face was carefully scaled. For the drilling, a gasoline air compressor of 150 cu.ft. of free air per minute capacity was set up near the foot of the cliff and served to operate two and



TYPICAL SECTION THROUGH FORT HORN

sometimes three "Jackhamer" precussion hand drills. The drill steels were made in 2-, 4-, 6- and 8-ft. lengths, with the starters 2 in. in diameter, and were gaged ⅛ in. between changes. Six-point bits were used as being less likely to stick in the seams. With a 60-lb. air pressure the actual drilling time for an 8-ft. hole in sound rock (Manhattan schist) was about 40 min. Ten holes were a good day's work. The drillrunners worked with ropes around them as a precaution in case of a slip. Each shot was covered by heavy rope mats held by blocks-and-falls from A-frames set back of the wall. About 100 cu.yd. of rock was removed without accident. Ed Connors was general foreman for the contractor.—Francis Donaldson, New York City.

A Special Track Design has been adopted for the depressed railway tracks on the new Southwark Piers now being completed by the Department of Wharves, Docks and Ferries, of Philadelphia, Penn. The main structure carrying the track consists of concrete crosswalls with embedded I-beams on



METHOD OF CARRYING RAILWAY TRACK ON SOUTHWARK PIERS, PHILADELPHIA

which rest stringers of I-beams embedded in concrete. The upper parts of these stringers protrude above the concrete and carry the track rails laid directly on the stringers. The details of the design and the method of fastening the rail to the stringers are shown in the accompanying drawing. This fastening consists of hook-bolts arranged in pairs and spaced at intervals of 2 ft. John Meigs is Director of the Department.

Editorials

Delays in Flood Protection

Flood-protective construction is easily the livest issue in the civil-engineering field at the present time. The organization of the Miami conservancy district and other reclamation districts in Ohio after more than a year of legal discussion means the start of definite planning on a large scale for many millions of expenditure.

It is a misfortune that the work has not yet reached the construction stage. With the contracting business in a state of starvation, as it is, the dike and dam and dredging contracts of Central States flood protection would have been a most desirable item to help in keeping the business alive and to maintain contractors' working organizations. The low contract prices which now prevail would not have been affected, so that the people who need the flood protection would have benefited in fullest measure from the slack condition of the business.

The reason why these desirable results are not realized is the fact that an excessive mental inertia had to be overcome. The teachings of the great flood—that protective works are urgently necessary—did not sink in. No city, county or state was willing to start. Not only this, but the Ohio Legislature directly evaded the problem; amid political intrigues it hurried its session to an end and adjourned, leaving the flood problem untouched for many months. The people of Columbus even rejected by popular vote a definite project for local protection. Under these circumstances one need not be surprised that it has taken more than two years to get the planning started and that the 1915 season finds practically no flood-protective work under way.

The destruction wrought by the Erie freshet ought to act as a warning alarm to those who still feel unsympathetic toward the movement for stream control. It directs attention also to the potential dangers residing in small streams. Heretofore it was commonly thought that the hydraulic possibilities of brooks and creeks are well known, since they are likely to get their maximum flow from a local thunderstorm. The Erie experience destroys this belief and shows that even insignificant little rivers need study and control.

Estimating the Value of New Inventions

The recent move made by Secretary Daniels to establish in the Navy Department a New Inventions Board to examine new inventions offered to the navy and select for development such as appear to be of promise calls attention to a very difficult but very important class of engineering work.

Many business men and not a few engineers look upon all work of this sort with frank skepticism. They will flatly deny that anyone, no matter what his experience and technical acquirements, is competent to pass judgment upon the merits of a new and untried invention and to say in advance of its actual demonstration whether it is promising or worthless.

In fairness to those who hold this belief, it should be said that in many cases where an opinion has to be given upon a new and wholly untried invention, the opinions of even the best technical experts may prove mistaken. Some factor which has not been taken into account may eventually cause a very promising invention to fail; or on the other hand may make a success of an invention which seemed hopeless.

But because an engineer's opinion on the merit of an invention may be in error is no more reason for rejecting it as worthless than it would be to reject the opinion of an attorney on a difficult legal question or that of a physician called in consultation in a serious case. The engineer who is competent to pass upon the merits of a new invention can give an opinion at least as reliable as the opinion of the able lawyer or the famous physician.

Further, the engineer can do what the lawyer or the physician cannot, that is, resort to physical tests to determine doubtful points and thus gradually accumulate data on which a reliable opinion can be based. This course will very often be advisable in the case of new inventions of radical novelty. Before deciding whether a new scheme is worth taking up for commercial development, tests of some of its cardinal features can be made, which will show whether its design is based on correct principles.

There is another reason for the widespread belief that nobody can tell in advance whether a new invention will succeed or fail. And this reason is that engineers competent to examine and pass upon new inventions and plan the development of those which are approved are comparatively rare.

It need hardly be said that if an engineer is to form reliable judgment upon the merits of an invention, he must be reasonably familiar with the art to which the invention applies. Hardly less important is it that he be of a fairminded and judical disposition and able to weigh without prejudice the claims of the inventor. A very large proportion of engineers are constitutionally disqualified for undertaking work of this sort. When an engineer is thoroughly familiar with an art he often acquires an unconscious prejudice against anything new and revolutionary which is proposed in it. He will demand of the inventor of a new appliance that it shall reach a degree of perfection in operation which old and familiar appliances have never attained. Such an engineer overlooks the defects in the methods and materials and appliances with which he is familiar because ways have been established for getting along with them, and he fails to appreciate that similar ways would eventually be found for the new and revolutionary method or appliance which is offered. It is the mental inertia of men of this class which makes the task of the inventor of a new appliance so difficult, as a rule.

While engineers with such a mental habit are disqualified for the task of passing on new inventions, there are engineers of another class who are equally disqualified.

These are the men of such sanguine temperament that they see advantages in everything new and fail to appreciate adequately the troubles that may develop.

One of the commonest mistakes made by engineers in passing upon inventions is to reject a scheme offhand because it is not new. Of course, from the limited point of view of patent protection the question of novelty is of importance; but in considering whether an invention may have merits justifying commercial development the matter of novelty should take a subordinate place. An invention may be brought forward and prove a failure at one time and after years of neglect it may again be taken up and the progress of the arts in the intermediate period may make it a great commercial success. Ball and roller bearings to reduce friction were invented very early in the history of mechanics, but they did not become of commercial importance until the development of accurate mechanical processes of producing balls and rollers at low cost made such bearings commercially practicable. Their extensive use, however, has come in very recent years, when instead of being made to order in small quantities such bearings are put on the market in standard sizes at so low a figure as to be available for use without serious expense in ordinary machine design.

Another highly important question to be settled in passing upon a new invention is that of its advantage over existing practice. Hundreds of ingenious schemes are brought forward every year to overcome difficulties that exist chiefly in the imagination of the inventor. An engineer must be intimate enough with an art to weigh fairly the advantages which the new invention proposes to establish over previous practice.

It is well to bear in mind also that the work of a competent "new inventions board," such as is proposed for the navy, and such as actually exist in the organization of progressive industrial concerns, is only begun when the promising new inventions are sifted out from among the impossible ones. The next step is to develop the selected inventions to the stage of mechanical and commercial success, and here again engineering ability of the very highest order is called for if the work is to be done with economy and practical advantage.

It will be evident that the work of a "new inventions board" is not a task to be undertaken by a set of men whose time is already fully occupied with their own business and professional work, such as those whose names have been announced from Washington. Nor is it work that can properly be done as a free contribution to the country's welfare. There is no more reason why such important and valuable work should be done for the Government without payment by members of the engineering profession than there is to expect the Government's most difficult tasks in the Department of Justice to be performed gratis by a committee of lawyers.

It is to be hoped that the eminent engineers and inventors and manufacturers who are to be brought together in the New Inventions Board may have a clear appreciation of the task before the Government and the way it should be handled, and that they may induce Congress to provide ways and means for the organization of such a board on a permanent basis, with a corps of carefully selected and well paid experts to carry on its work. By such means, and such means only, can the United States Navy be enabled to keep pace with its foreign rivals in the race for efficiency.

Assessing Costs of Railway Grade-Crossing Removal

In the present general scheme of railway improvement a prominent and costly item is the elimination of street crossings at grade in cities and towns. Work of this kind is in progress and in contemplation in many places, and is increasing steadily. It applies not only to the large cities but also to many smaller places where the danger or interruption to traffic reaches a degree that leads the municipality to demand an improvement in the conditions.

The aggregate cost of this work is enormous, and by far the greater proportion of this cost is paid by the railways. On the other hand, the benefits are mainly in the interests of the public and the municipality. Such benefits as accrue to the railway result from a reduction in liability to accidents and claims for damages and some greater facility in handling the traffic, especially where traffic is heavy and movements are hampered by a long succession of crossings, with their gates and watchmen. In certain cases the elimination of crossings may effect or permit a reduction in grade or other similar improvement, but such incidental improvement is obtained usually at a cost far in excess of the value of the improvement, and far beyond what the railway could reasonably or economically pay under ordinary conditions.

The work is of a costly character throughout. Limitations of right-of-way and cost of land usually necessitate masonry retaining walls for either a cut or a fill. The bridge work is costly, and must usually provide for solid waterproof decks. In many cases ornamental treatment of the metal work, or its incasement in concrete with such treatment, adds materially to the cost of the bridges. In addition to this every case involves special problems and difficulties, all tending to increase the cost. Another important cause of expense is the necessity of keeping both streets and tracks in service during the execution of the work.

Interference with sewers and water mains and changes in street grades involve additional cost, which may be borne in part or wholly by the municipality. Maintaining connections with industries under the altered conditions may also involve heavy cost, which may be borne (or at least shared) by the industries. Where a railway grade crossing has to be eliminated in addition to the street crossings there is a further and material increase in cost.

In considering problems of grade-crossing elimination the solution should be sought on a mutual basis of consideration for the interests of the public, the municipality and the railway. Unfortunately, it is too often a case of antagonism and opposition, the municipality trying to get all the concessions possible and to assume the smallest possible share in the expense, while the railway seeks to head off the demands and to limit the cost of its work. The result may be a compromise not really satisfactory to the city or the company, and involving a certain amount of ill-feeling on both sides.

As an instance, in one case a city endeavored to compel a railway to depress its tracks to such an extent as to require no change in street grades, the entire cost of the work to be imposed upon the railway. The latter opposed this successfully in the courts. The adopted plan included a partial depression of the tracks, elevation of

the streets, and a sharing of the cost. On the other hand, a railway proposed to carry its track elevation across a public square by a bare steel viaduct with open floor. This was opposed by the city, and the adopted plan provided for a water-tight deck and the masking of the steel structure with concrete for the sake of appearance.

With problems of this kind on the increase it is to be hoped that there will be a more general recognition and impartial consideration of the public and private rights.

A Real State Engineer

A merry to-do is likely to arise over the new Wisconsin law which concentrates the whole engineering work of the state government in the hands of one man—a state chief engineer. It is a revolutionary law. It will deprive the highway bureau's engineer, for instance, of his title to independence and will make him a mere subordinate of the chief engineer. Such a state of affairs is subversive of all established practices in state administration—and the same is true of city and national administration. As in many other matters, Wisconsin leads with a piece of radical legislation.

The question is: What is engineering work? Are the topographical survey operations conducted by the state geological survey to be classed as engineering service? Is a state building inspector an engineering employee? Today, nobody knows; even the American Society of Civil Engineers does not know. But we will know in a short time, possibly, when the Wisconsin courts decide on the interpretation of the new law. Of course the intent of the law is obvious—to bring under the control of one technically competent head all such state work as must be performed by engineers. If the topographical surveyor is an engineer, then the chief engineer under the law ought to have jurisdiction over him. Conversely, those state officials and employees who by the Wisconsin court decisions are placed under the chief engineer's jurisdiction will thereby be classed as engineers. This result will be very helpful, since no definition of "engineer" has been formulated hitherto. But the wonder of it—that Wisconsin law courts should give instruction to the American Society of Civil Engineers.

One Field That Is Booming

The world has always spent a good deal of money in amusing itself, but it is doubtful if ever before there has been a time when this money has so benefited the building constructor as at the present, when, to say the least, new enterprises for construction are not frequent. Whatever may be the prospect for increased construction work in the more practical fields, there seems to be no lack of capital for amusement enterprises.

In this issue of *Engineering News* there are illustrated two large pieces of such engineering work, aggregating in total cost some $3,000,000 and involving not only a fairly intricate design, but a construction made doubly complicated by requirements of exceptional speed. These two—the Sheepshead Bay Speedway and the Boston Ball Park—are but typical of a great quantity of such work under way or recently completed in widely distributed sections of the United States.

Of course every city worthy of the name has its ball park, but most of these mean work only for the local carpenter and builder. In the "big-league" towns, however, the ball park has become a formidable piece of engineering construction, more or less standardized to be sure, but nevertheless requiring careful design and as a rule rapid construction. The same may be said of the ever-increasing number of stadiums, without which nowadays no university can properly instruct youth. To call to mind the enormous piles of concrete at Harvard, Princeton, Chicago, Syracuse, College of the City of New York, to say nothing of the municipal stadiums at San Diego and Tacoma, can but emphasize the great number of dollars invested in property which has brought nothing but, to quote the economist, "psychical wealth" to the world.

The motor speedway is a more modern development, but is a natural growth from the horse racing and later cycle track, with the additional requirements of size to care for attendance running up toward 100,000 and of strength imposed by the high-powered and high-speed automobile. Engineering talent is required in the design and layout of such tracks and constructive ability of a high sort in their quick erection. The Sheepshead Bay track is the largest of the lot, but similar tracks in Philadelphia, Providence, Louisville, Chicago and St. Paul are under way. At another time attention will be called to some of the problems of design in such tracks and particularly to the great variation in the surfacing used on the tracks so far built. Meanwhile, it is pleasant to note that the engineer and contractor are getting a part, though only a small part, of the vast sums of money spent by the American people in recreation.

Busy days are in prospect for engineers who go to San Francisco to attend the numerous conventions of technical societies which are to be held there in September and October. Only a few of these societies have as yet sent out their programs for the convenience of those who wish to plan their time in advance. Under "Society Proceedings," elsewhere in this issue, will be found a synopsis of the program of the International Engineering Congress, prepared from an advance typewritten copy.

Without disclosing any secrets, it may be stated with certainty that the program, entertainment and exhibit committees of the New England Water-Works Association have done their part toward making the convention which is to be held in New York from Sept. 7 to 9 a success. The membership at large may be counted on to do the rest. The convention will meet a day earlier in the week than usual, for the convenience of members who wish to take the Engineering Congress train for San Francisco on Sept. 10.

For the second time in two years the conventions of the American Public Health Association and the New England Water-Works Association clash. This seems to be a shortsighted policy in view of the members and officials common to both organizations. It seems as though a conflict of dates might be easily prevented in the future if only some attention were given to the matter by those having the interests of each association at heart. It may be added that the convention of the American Public Health Association at Rochester on Sept. 7 to 10 promises to be a good one. This makes it all the more a pity that the two conventions come on the same days.

Letters to the Editor

How Engineers Earn Fees

Sir—The writer noticed an article recently in one of the road journals entitled "Has the Contractor a Snap?" This article set forth items of contingent cost that are generally overlooked by contractors. It occurred to me that the contractor is not alone in being misunderstood for few people outside the engineering profession realize what the engineer has to contend with, especially in municipal work. In my practice I have continually been told that engineers earn their money only too easily. I am therefore prompted to write this letter to you.

The question "Has the Engineer a Snap?" may be answered perhaps better after itemizing the expense and trouble which the engineer must undergo, some of which are as follows:

1. Expense of looking over the proposed work and closing the contract for employment.
2. Expense of making necessary investigations and surveys.
3. Expense of getting out report.
4. Expense of traveling and time in submitting report.
5. Expense of time in convincing clients and local "home-grown" or "native" engineers that the report, plans and specifications are correct, or rather *trying* to convince them.
6. Expense of defending plans, specifications and ideas against the "butting-in" engineer.
7. Expense of assisting clients to carry on a campaign of education against the onslaughts of the public.
8. Expense of getting out the final working plans, specifications and estimates.
9. Expense of attending letting for construction work and for purchasing of materials, machinery, etc., and assisting clients in getting *legal* contracts closed up.
10. Expense caused by having to defend plans and specifications against the "salesman-engineer," who has something to sell, and promoters of "blue-sky" schemes, who pose as public benefactors and do everything that they possibly can to have the specifications drawn so that competition is eliminated. (These same fellows are always the first ones to howl if the specification is closed against their particular article, and I have noticed that their particular article is always the best.)
11. Expense of time in examining forms or bonds to be furnished by the contractors.
12. Expense of time in approving manufacturer's plans of machinery, details, etc.
13. Expense of time in getting contractor started on his work.
14. Expense of starting resident engineer out on the work.
15. Expense in straightening a hundred trivial matters as the work progresses. (The resident engineer can handle the situation, but clients always want the "main guy" on the ground in person.)
16. Expense of making final inspection and test of the work.
17. Expense of getting out complete record, plans and maps.
18. Expense of time in getting plant running in good shape.
19. Expense of time in getting what is coming to one of the "balance due."
20. Expense of taking a vacation to recuperate and nurse oneself back to health.

W. L. BENHAM.

Oklahoma City, Okla., July 26, 1915.

Engineering Students Should Practice Public Speaking

Sir—There have been several interesting articles of late in *Engineering News* regarding the status of the engineer and why as a professional man he does not hold the positions he should relative to the other professions. I think Mr. Benham, of Oklahoma City, Okla., struck the keynote in his article, "Engineering Students Should Practice Public Speaking," in the issue of July 15, 1915.

Nearly everyone will admit that no profession renders greater service to mankind than the engineering profession, not only materially, but in the comforts and conveniences it brings and in the impetus it gives to better things—to religion, culture and philosophy. These questions then naturally arise: Why does the engineer not enjoy the prestige other professional men do? Why does he not receive the credit due him for the service he renders? Why is he not a properly balanced man?

And the reason? The engineer does not receive enough publicity. He is too unassuming. He does not "mix." He does not assert himself and his deeds enough. In fact he requires a publicity agent; and he must needs be his own, for no one else is willing to fill this office for him. In the apt words of the young philosopher: "He who tooteth not his own horn the same shall not be tooted."

The fault lies, it seems to me, in our colleges and schools where the future engineers receive their training, although it is being remedied at present in some instances. In the university the engineering students constitute the hardest working, most self-centered and self-contained group. (And no doubt the engineer educated in the university is broader than his brother of the technical school, or at least he should be.) They have few interests outside their own studies, which occupy nearly all their time. They are not good "mixers" as a rule. They take no part in literary societies or public exercises of any sort. They are quiet, hard-working, unassuming, and therefore little known among the student body. And do not these characteristics prevail among the older engineers of your acquaintance who are practicing their profession? The fault must lie, then, in their early training.

Where is the remedy? It, too, lies in our colleges and schools. There should be literary societies, public speaking or entertainments of some kind that would place the student before the public or before an audience and give

him valuable training as well as valuable advertising. This is an age of advertising, and the engineer must "get into the game" and advertise himself.

I heard a prominent highway official of this state say not long ago that the art of public speaking was one of the most important attainments of the engineer of today. This official is an able speaker himself, and he owes his success largely to his ability to talk to an audience entertainingly on technical subjects.

It behooves our schools of today to prepare the engineer of tomorrow for elevation to the position he deserves to hold among the other professionals.

J. S. MILLER.

Wharncliffe, W. Va., July 31, 1915.

Danger in Vessel Operation

Sir—The capsize of the "Eastland" has revealed to the public an amazing disregard of public safety in connection with the stability of vessels and has given rise to a general public demand for a more efficient inspection of passenger transport by water than that now existing. With reference to this, two personal experiences of the writer may be worth putting on record.

In 1892 while living in Chicago I went on several excursions between Chicago and Michigan City by the exact route, I believe, which was to have been followed by the "Eastland" on the day when it came to its disastrous end. The boats I traveled on in those days were so unstable that the stability of the craft was maintained by a rolling ballast operated as follows: On the lowest deck there were about twenty heavy barrels, specially hooped and containing lead for weight. Against the center post in the lower deck was suspended a wooden pendulum about 10 ft. long. A foreman sat on a box and watched the pendulum, and as the dear people were enjoying themselves and moving from one side of the ship to the other on the upper decks, he would swear and yell at his men to roll the barrels to the side necessary to trim the boat, as indicated by the motion of the pendulum. Just what "formula" was used to make the travelers safe I never knew, and I doubt very much whether in any other country in the world such trifling with danger would be permitted.

Another trip I once made was from Seattle to San Francisco on a steamer whose name as I now remember it was "The Queen." She was a beautifully painted vessel with a lot of woodwork above her water line and the usual big steel smoke-stacks coming up through the decks. Shortly before beginning this trip "The Queen" had lost one of her propeller blades, and the chief engineer told me, in explaining why he was running the engines at such high speed, that the captain had determined that he would take his 300 passengers into San Francisco on time by using forced draft to make up for the loss of efficiency resulting from the missing blade. In consequence of this forced draft, the smoke-stacks were so hot all the time that we enjoyed the spectacle of laborers sitting on each deck playing a hose on the woodwork around the stacks for 2½ days during the entire trip to San Francisco. We reached there on time and of course hugely enjoyed the extraordinary provisions for our safety and comfort.

I doubt very much, however, whether similar laxness would be permitted in any other country in the world. With you and all other good citizens I hope some day for the existence of a nonpolitical, practical and highly scientific vessel-inspection system in the United States that will protect our country from such disgraceful occurrences as the appalling "Eastland" disaster.

C. L. H.

New York, July 31, 1915.

Give the Experienced Engineer a Chance in Highway Work

Sir—If city and state highway departments would or could employ experienced engineers instead of young college men with little or no practical experience thousands of dollars would be saved the public on work the cost of which annually mounts into millions of dollars.

One doesn't find a young and inexperienced physician acting as head surgeon in a big hospital, nor a young law student acting as counsel of a big corporation, but to see an inexperienced young college man directing the expenditure of thousands of dollars on public road work is common.

It is very easy to waste money in highway work on account of poor location, a branch of engineering which requires long and thorough experience both in preliminary and construction work. The inexperienced man in nine cases out of ten takes the easiest route known to the general public, simply because he has little or no confidence in himself and fears the result of a mistake. On the other hand, I know many old railway locating engineers who are out of employment at the present time because of poor business conditions throughout the country—men who have successfully located miles and miles of railroads in the United States, yet today they would be glad to make $75 per month.

Our engineering societies ought to make some protest over this condition of affairs. Are those men who have met with success in engineering and whose employment would save the public many thousands of dollars to be allowed to sit idle, or should they and the public be given a helping hand?

The great trouble in getting men for highway work is generally that a man must travel several miles to a large city to take a written examination, and in a written examination the younger college men will beat the experienced engineer every time. It often happens in the Central West that a big university is turning out men in the very city where the Chief Highway Engineer is located and that these students get in on the ground floor when it comes to filling up the Highway Department staff.

There should be a system similar to that which the great railroad companies have of hiring men on their record of past experience. I do not want college students to misconstrue my meaning in writing this letter, for although it looks as though I was down on the college man, this is far from true. The college man is the best man without a doubt, but he should start from the bottom of the ladder and work up, the same as others have, as far back as I can remember, until this state highway work started up.

A. R. MIELLY.

New Orleans, La., Aug. 7, 1915.

The Mineral Production of Alaska to the close of 1914 is estimated at $268,150,000, of which $244,000,000 was gold. The territory's mineral production in 1914 was valued at $15,764,000 and included about 21,500,000 lb. of copper.

National League Ball Park at Boston, Mass.

SYNOPSIS—The largest ball park in the country. Seats 40,000 people. Built in five months. Reinforced-concrete stands, fence and club house. Nearly 100,000 cu.yd. of grading required.

The Boston National League Base Ball Club opened on Aug. 18 its new park in the Allston district, only 15 min. by street car from the business center of Boston. The park is located on a tract of land which up to last spring was a golf club, situated between Commonwealth Ave. on the south and the tracks of the Boston & Albany R.R. on the north, with the Charles River beyond. The site was not turned over to the contractor until Mar. 20 of this year, and the opening game in the practically completed park was held on Aug. 18. This remarkably fast contract work comprised the excavation and transfer from cut to fill of about 100,000 cu.yd. of earth, the placing of a number of piles under the footings of the stands, the erection of stands capable of seating 40,000 people, the construction of a large club house and a reinforced-concrete fence entirely surrounding the grounds, and the leveling of a parking space outside of the grounds where automobiles and street cars can stand during the game.

Fig. 4 shows the general layout of the park and Fig. 1 is a view of the grounds looking north across them, taken about the first of April, just as work commenced. It will be seen that there existed on the golf course a sizable pond which had to be filled in at the beginning of the work. The ground was rolling, and steam-shovel excavation consisted in leveling up the playing field, in filling the pond, and in excavating for the lower part of some of the stands, the fill being taken by horse and wagon to make the slope in the upper part of the stand. This operation resulted in the level of the playing field being nearly 20 ft. lower than the level of the concourse back of the stand, and also it required the lower part of some of the stands to be built directly on the ground, as shown in Fig. 5, while the upper parts are built on the customary columns.

The distinguishing feature of the field from the lay viewpoint is its extreme size. As may be noted in Fig. 4,

FIG. 2. BOSTON "BRAVES" BALL PARK ON JUNE 23, 1915, AFTER THREE MONTHS' WORK

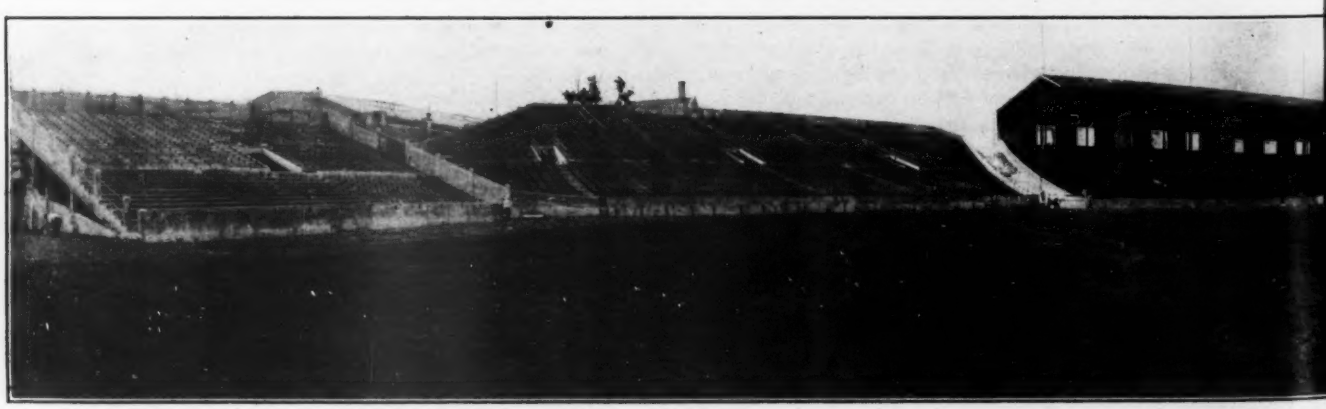
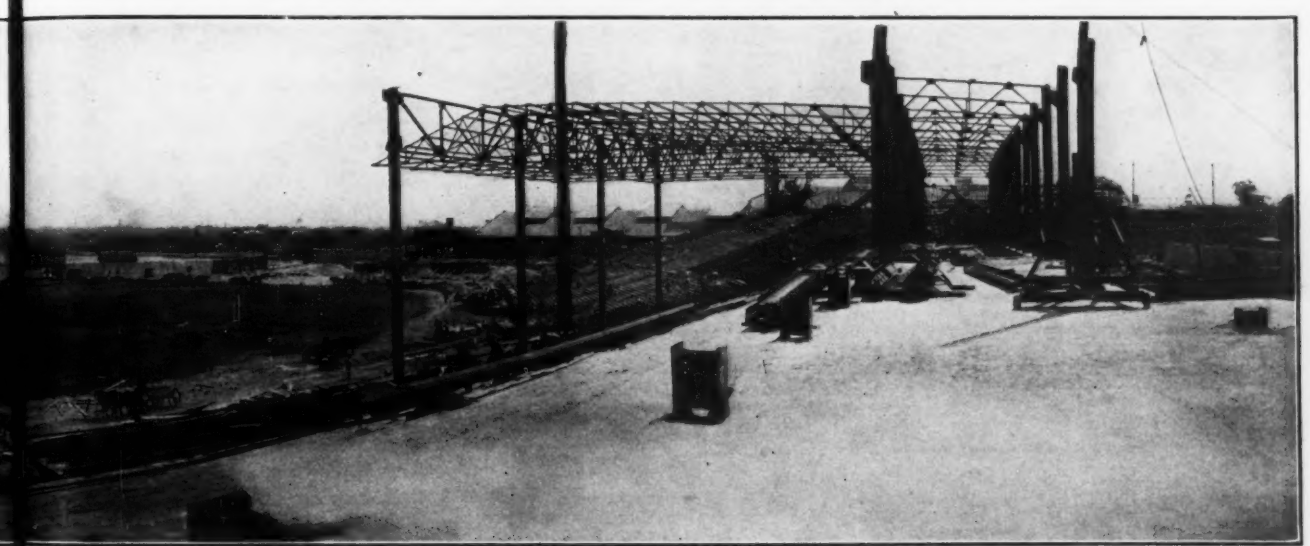


FIG. 3. LOOKING OVER THE PLAYING FIELD TOWARD THE STANDS, AUG. 16, 1915, TWO DAYS

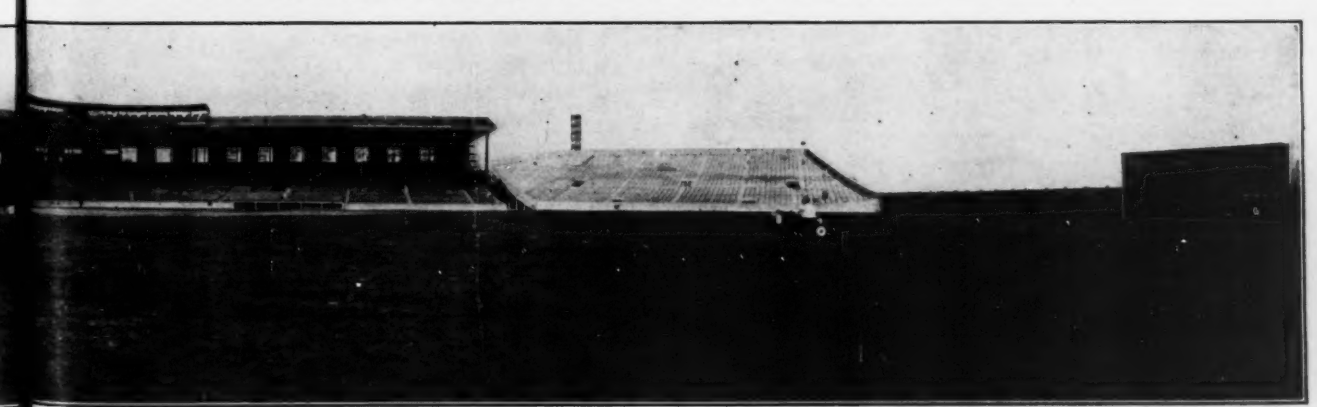
the home plate is 350 ft. distant along the foul line from the nearest point on the stand, while the bleachers and the far side of the pavilions are so far distant from the diamond as to remove all danger of batting a fair ball into a stand. The total area of the inclosure is 15 acres.

Three types of structure were used in the stands—the grandstand, the pavilions and the bleachers, graded according to price of admission. These were laid out in circular plan as shown in Fig. 4, A detail of a section through the grandstand is shown in Fig. 5. The ground

FIG. 1. SITE OF BALL PARK ON APR. 1. 1915, ABOUT A WEEK AFTER WORK COMMENCED



WORK. GRANDSTAND CONCRETE COMPLETED, PAVILION CONCRETE BEING LAID



DAYS BEFORE THE OPENING OF THE PARK. TWENTY WEEKS FROM FIG. 1 TO FIG. 3

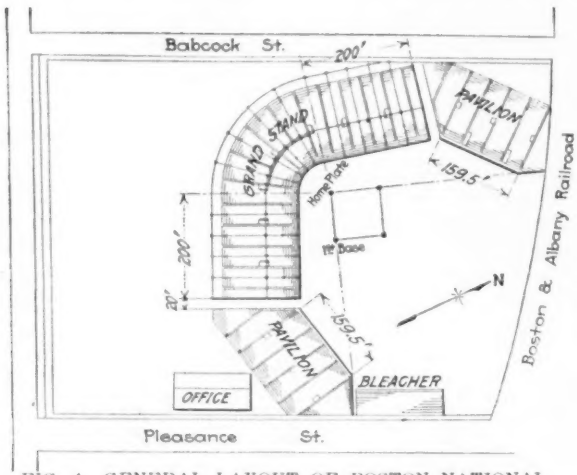


FIG. 4. GENERAL LAYOUT OF BOSTON NATIONAL LEAGUE BALL PARK

on which the grandstand was built is partly in cut and partly in fill, though the fill is not shown in the particular section drawn in the figure.

The slope of the stands is designed to afford a good view of the diamond from every point. The lower steps, in front of the boxes, have a 3-ft. tread and 3-in. rise, and the main steps increase in rise from 5½ in. at the bottom to 10½ in. at the top, with a uniform tread of 2½ ft. The seats themselves rest on concrete steps in the lower part laid directly on the ground and reinforced along the bottom with a plane of wire mesh. Above the ground the steps are of the same relative slope and size, but are of reinforced concrete, of the design shown in Fig. 5, resting on stringers, which in turn rest on columns spaced 20 ft. transversely and 10 to 17 ft. longitudinally, according to the requirements of the layout.

The columns and stringers are of structural-steel members framed together at the junctures and incased with concrete, according to the details shown in Fig. 5. At the

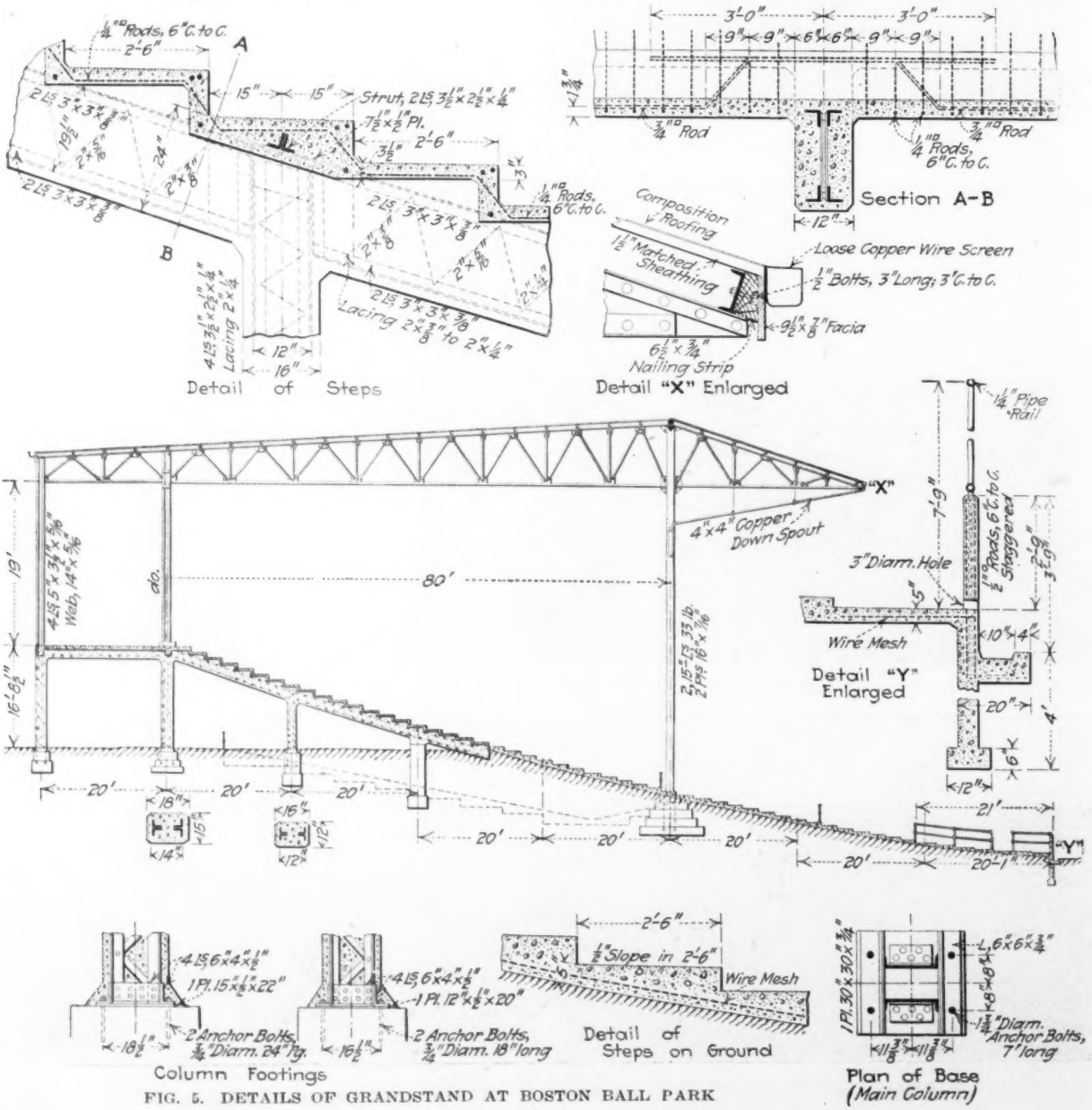


FIG. 5. DETAILS OF GRANDSTAND AT BOSTON BALL PARK

rear bay of the span the structural steel of the concrete and steel columns is extended up to form the columns for the grandstand roof, which extends forward and is carried on columns rising directly from footings near the forward end of the stand. The rear columns are connected by hollow-tile plastered to form curtain walls. The stands are separated from the field by a reinforced-concrete fence shown in Fig. 5. In the grandstand the seats are of the folding individual type, bolted down to the concrete steps.

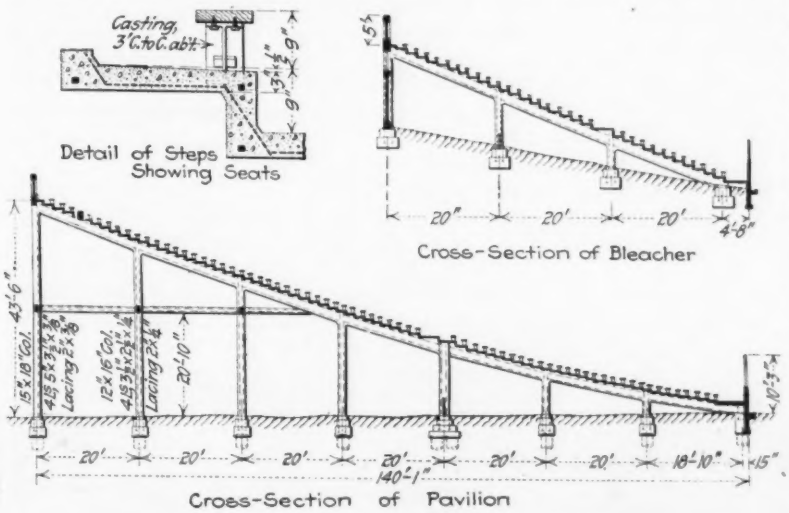


FIG. 6. PAVILIONS AND BLEACHER SECTIONS

The pavilions and bleachers are of the general section shown in Fig. 6 and of structural detail corresponding to the typical detail given in Fig. 5. The difference between these stands and the grandstand is that there is no cover, and that instead of folding seats there are benches screwed down to permanent cast-iron standards. The framing details are the same as in the grandstand, except where space required cross-bracing girders to stiffen the columns. All stands are approached by ramps through the structure and up to the rear promenade. The boxes at the front of the grandstand are entered from downward-sloping inclines, as shown by dotted lines in Fig. 5.

All the columns under the grandstand and pavilion B were founded on concrete piles of the "pedestal" type, driven by the MacArthur Concrete Pile & Foundation Co. For these footings 305 piles, of an average length of 20 ft., were driven singly or in groups of from two to thirteen per footing. The soil consisted of the loam fill, brought in most cases from the remainder of the field and underlain with sand and gravel. Piling was especially required over the site of the old pond.

The office and club house at the entrance to the field is a three-story building of pleasing design, mainly of reinforced concrete. The fence which surrounds the site is 12 ft. high and has a vertical reinforced-concrete slab between posts spaced every 12 ft., with an expansion joint at every fourth post. At the rear of the playing field the revised ground elevation is so far above the tracks of the Boston & Albany R.R. that a 19-ft. concrete retaining wall was required to protect the tracks, the usual 12-ft. fence being superposed on the wall.

Construction work was naturally carried out by a very large force on account of the short time which was permitted for the work. Steam-shovel excavation into wagons cared for the cut and fill in the first part of the work. Then followed the erection of the steel reinforcing the columns and girders in the upper part of the stand and the direct laying of the concrete steps at the lower part of the seats. As soon as the steelwork was up, the girders were connected with wooden forms and the concrete poured from a high tower and chute which permitted the movement of the chute to any location on a very large section of the stand. There were two such plants and the towers moved from place to place to cover the section under way.

The making of a playing field was one of the first things started in the work. As soon as the leveling-up process was completed subsoil and sodding work was started, so that even before the stands were fairly along the diamond and the outlying parts were well toward completion (Fig. 2). This was necessary so that the field would be in perfect condition by the time the first game was played.

The view in Fig. 3, taken Aug. 16, only two days before the opening game, shows that the park was practically completed in the very short time allowed—less than five months.

The structural design of the stands was in charge of the Osborn Engineering Co., of Cleveland, Ohio, and the construction was carried out by the James E. Gaffney Co., the president of which, James E. Gaffney, is also president of the Boston National League Club. R. G. Collins, Jr., was Engineer of Construction.

More Flood-District Filling in Pittsburgh Begun

Following the extensive flood-filling enterprise carried out by the city of Pittsburgh on the north side (Allegheny) a few years ago, a large piece of filling work on the Pittsburgh side was recently started by M. O'Herron, contractor.

The work is on Duquesne Way and Penn Ave. and the transverse streets from Water St. to 7th or Sandusky St., with some minor work extending as far as 11th St. This territory is to be raised to El. 33.9, the Allegheny filling having been carried up to El. 33.

The work is distinguished by the novel street drainage system adopted. The streets were laid out without longitudinal slope, so that gutters will not perform their ordinary service. Longitudinal 12-in. drains are laid under the street near the curb, receiving branch pipes from street inlets located in the curb about 40 to 60 ft. apart. These special storm sewers discharge into the transverse or main outfall sewers in the cross streets.

Lime Production in 1914—The lime made in the United States in 1914 as reported by the United States Geological Survey amounted to 3,380,928 tons, valued at $13,247,676. The plants operating were reduced from 1023 in 1913 to 954 in 1914. The number of kilns in operation increased from 2338 in 1913 to 2374 in 1914. The most marked feature of the lime industry since 1906 has been the rapid growth in the production of hydrated lime, which in 1913 had increased over 300% in both quantity and value.

News of the Engineering World

Progress on Hetch Hetchy Water-Supply

Despite the fact that construction work on the Hetch Hetchy water-supply for San Francisco has been greatly handicapped by lack of funds, as a result of the European War and the consequent stringency of the money market which has prevented the sale of 4½-per cent. municipal bonds, all of the work necessary to comply with the terms of the Raker Act is being rushed by City Engineer O'Shaughnessy, and the great task of bringing Sierra water to San Francisco is well under way.

Work has been started at Early Intake on a tunnel 10½ ft. in diameter, which will be a part of the permanent main aqueduct, and pass through a formation of solid granite for a distance of 20 mi. to a forebay reservoir, and thence to the Moccasin Creek power station. The Early Intake is 12 mi. downstream from Hetch Hetchy Valley, at an elevation of 2320 ft. above sea level. To facilitate the proposed tunnel construction, work is being rushed on a branch wagon road 3 mi. long and 14 ft. wide from Early Intake to the main transportation road, 10 mi. of which has recently been completed by the Utah Construction Co. The Early Intake road runs from the crest of the ridge to the bottom of Tuolumne River cañon, through a particularly rugged country, all of which is in a granite formation. This branch road is now 80 per cent. completed.

San Francisco owns a large amount of timber on Cañon Ranch, an area of 160 acres, between Hog Ranch and Hetch Hetchy Valley. Because of the high cost of lumber in the open market, the city engineer deemed it advisable to erect a sawmill on Cañon Ranch. A contract for the mill equipment was awarded on Apr. 19, 1915, to the Eby Machinery Co. The mill was put in operation on July 30 and will be run continuously. All of the timber for the forms to be used in concrete construction in and near the dam, railroad ties for use in the transportation road, lumber for camp buildings and other purposes will be supplied by this mill.

Work will be begun during August on clearing of timber that portion of the floor of Hetch Hetchy Valley that will be flooded by the construction of the Hetch Hetchy diversion dam. A wagon road has been completed from the bench above the dam site to the floor of the valley. All of the timber cut in the reservoir will be used for tunnel work, railroad ties, poles and forms. On account of the inaccessibility of the valley it would not be profitable to sell any of the wood to outside markets.

A portion of the Hetch Hetchy Valley will be flooded this winter by the construction of a small diversion dam and diversion tunnel to bypass the waters of the Tuolumne River around the main dam while the latter structure is being built next year. That portion of the reservoir which will be under the waters of the lake thus formed will be the first to be cleared of timber.

CONSTRUCTION WORK ON NEW HETCH HETCHY WATER-SUPPLY, SAN FRANCISCO, CALIF.

Left—City sawmill cutting lumber for forms and camp buildings. Right—Cut on new road built by city

A very extensive study was made of the design of a cyclopean concrete dam to be constructed on the Tuolumne River at the lower end of Hetch Hetchy Valley. Every type of arch and gravity section was considered, and a gravity dam, arched as an additional safety factor, was tentatively chosen as the type best adapted to local conditions at the dam site. This dam will be 300 ft. high and will have a crest length of 750 ft. Its cost will be approximately $4,000,000. The design has just been completed by the city engineer.

City Engineer O'Shaughnessy has been exerting strenuous efforts to make an arrangement by which contractors would construct the 67 mi. of railway from Rosasco, on the Sierra R.R., to the Hetch Hetchy dam site this year, and accept 4½ per cent. Hetch Hetchy bonds in payment. Two local representatives of one of the largest contracting firms in America are now in the valley, figuring on this work. The cost of this railway is estimated by the city engineer at approximately $1,850,000. He is hopeful that funds will soon be procured for this purpose.

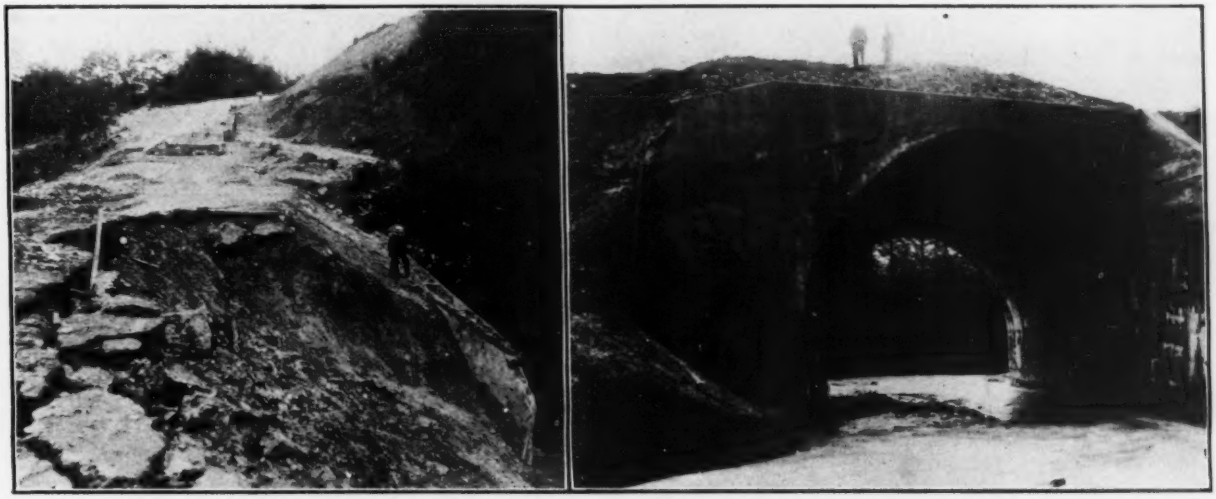
Road and Culvert Washout

The accompanying photographs show a washout on a new fill on the New York State road near Westfield, N. Y., caused by the very heavy rain of Aug. 9. The fill had recently been made over the arch bridge shown in Fig. 2, and was retained mainly by the wings of that bridge. After preliminary gullying the fill was washed out, as shown in Fig. 1, following the failure of one of the wing walls, as shown in Fig. 2.

A State Civil and Mechanical Engineer and Architect

A notable law has just been passed by the Wisconsin legislature and approved by the governor, creating the office of state engineer with a broad range of duties.

The chief engineer is to be appointed by the Railroad Commission and may be removed by the governor upon hearing. This chief engineer has three lines of duty—engineering for all state departments and bureaus, architectural services to the state, and supervision over and improvement of power, heating and similar plants of public institutions.



FIGS. 1 AND 2. WASHOUT ON STATE ROAD NEAR WESTFIELD, N. Y.
The two men are standing at about the same place in each view

Engineering—He is to have charge of all engineering performed by or for the state or any of the departments, boards, or commissions of the state, or in the promotion of any engineering or architectural projects undertaken by the state. He shall furnish engineering services to any branch or department of the state upon requisition. Provision is made for having engineering or architectural work done by contract, in which case, however, the chief engineer shall act with the administrative officers in letting such contracts, and he shall audit claims under it. Where any department, board, etc., requires permanent engineering service the chief engineer will appoint assistants to do such work, to be designated state highway engineer, state architect, university architect, etc., as may be appropriate.

Architectural Service—The duties of the chief engineer as to architectural service are described by exactly the same wording as that defining engineering service. To what extent outside architects will be called in for state work apparently will depend on the future attitude of the heads of state departments and the opinions of the chief engineer combined.

State Power-Plant Supervision—The chief engineer is required to examine and inquire into the matter of operating all state-owned power and electric plants, pumping or heating stations and to direct such changes in the methods or processes employed as will result in the most economical and efficient operation thereof. The superintendents of such plants must keep suitable records as directed by the chief engineer. In his annual report the chief engineer must show in tabular form the cost of operation per unit of product or service of each power or electric plant, heating or pumping station operated by any state institution.

This is the first case of a state creating the office of chief engineer to handle all classes of engineering service for the state, not to speak of architectural service. The importance of the railroad commission is still further increased by the new law. The railroad, utilities, and water-power work of the commission's engineering department presumably will be handled in future merely by one of the departments or branches under the chief engineer.

"Spiral Mushroom" Flat Slab Also an Infringement

As noted in *Engineering News* of June 24, 1915, p. 1245, a perpetual injunction was issued on June 9 against C. A. P. Turner, of Minneapolis, Minn., restraining him from "directly or indirectly making, constructing, using or vending to others to be used . . . reinforced-concrete flooring for buildings, containing or employing the invention described and patented in Norcross letters patent No. 698,542, or any . . . flooring . . . similar to those heretofore constructed . . . by . . . C. A. P. Turner under and in accordance with letters patent Nos. 985,119 and 1,003,384." Subsequent to that the C. A. P. Turner Co. marketed a type of flat-slab construction known as the "spiral mushroom," which was illustrated in

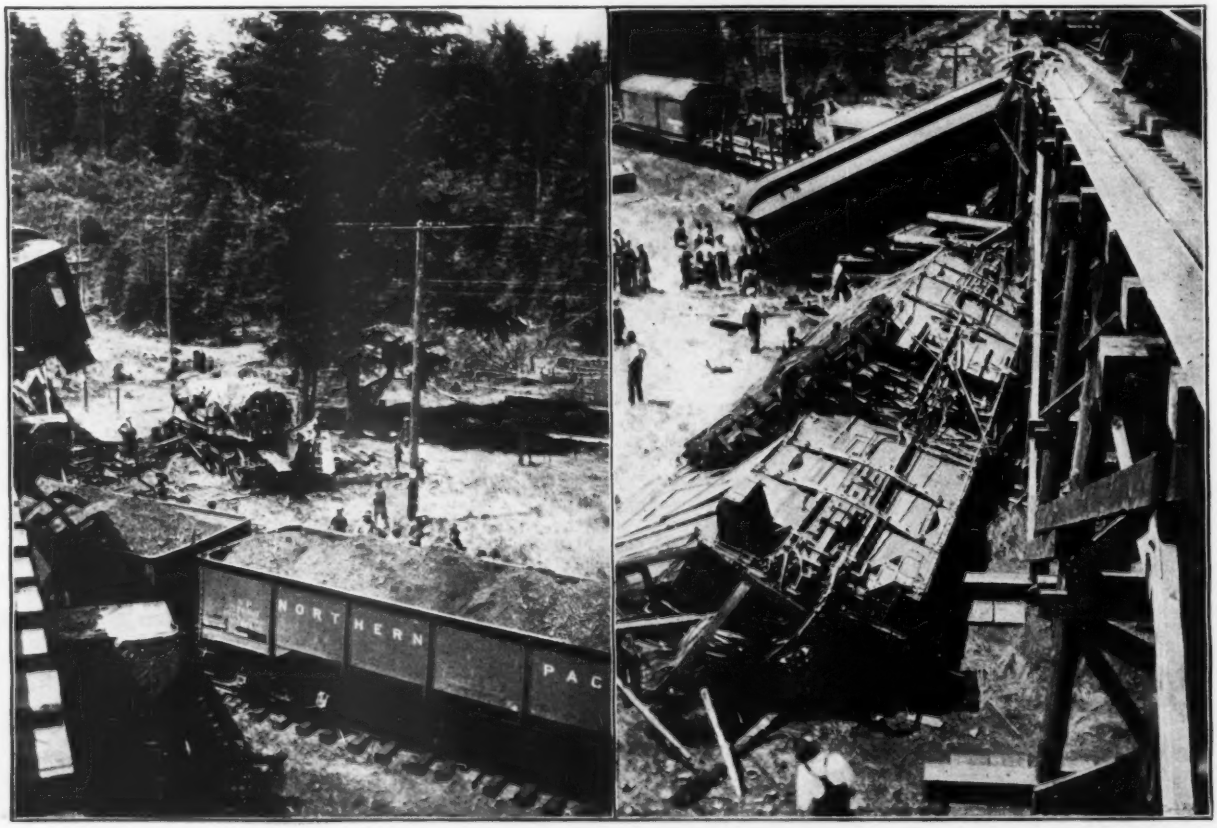
Engineering News of July 15, 1915, p. 144. Under date of Aug. 3, 1915, the United States District Court at Minneapolis decided that this later design came in the same category as Mr. Turner's previous design and that the injunction still held against the later design. The court fined Mr. Turner $200 for violating the injunction.

Train Goes Through a Trestle Just Weakened by a Blow

An unusual railway accident occurred on a trestle at Rainier, Wash., on the Gray's Harbor branch of the Chicago, Milwaukee & St. Paul R.R., in which three persons were killed and sixteen injured, as noted in *Engineering News*, July 15. Just before the Milwaukee passenger train appeared, a freight passed under the trestle on the tracks of the Northern Pacific Ry. A crane arm carried on a car of the freight train worked loose, and swinging out caught a diagonal cross-stringer of the trestle, tearing out a bent. Although an attempt was made to flag the passenger train, it was impossible to stop it before it reached the trestle. The wreckage is shown in the three accompanying photographs, furnished by J. R. West, Chief Engineer, Port of Seattle, who with his family was traveling in the parlor car of the passenger train. Of the three cars this was the only one that remained on the trestle.

The cause of the trouble was the insecure roping of the crane on the freight car. This was done by an inexperienced employee of the construction company owning the crane. The Northern Pacific Ry. did not inspect this car and crane. George F. Yantis, prosecutor of Thurston County, Washington, stated in his formal findings that "while there is some evidence of negligence on the part of the Northern Pacific agents in receiving and moving the car on which was the crane, it does not seem that the negligence was of such nature as should render the agents criminally liable under our law."

FIG. 3. PARLOR CAR LEFT ON TRESTLE; DAY COACH SMASHED; SMOKER PROPPED AGAINST TRESTLE



FIGS. 1 AND 2. VIEWS OF THE WRECKAGE

Fig. 1—View from front end of parlor car; shows Northern Pacific train on lower level, locomotive in distance. Fig. 2—Smashed day coach in which 17 of the 18 passengers were badly injured

The office of coroner has been abolished in Thurston County, which of course prevented an inquest. Instead, a justice of the peace took evidence and furnished the prosecutor with a transcript. It was the duty of the prosecutor to file formal findings and these took the place of a coroner's jury verdict.

Commission to Make Plans for New York Harbor

The committee on port and terminal facilities for the City of New York (made up of the Comptroller, the President of the Borough of Manhattan, the President of the Borough of Brooklyn, and the Commissioner of Docks and Ferries) has recommended to the Board of Estimate and Apportionment that a commission be appointed with instructions to investigate thoroughly the problem of dock improvement in the City of New York and to produce a plan for the proper development of that port. The committee further recommended the appointment to that commission of John F. Stevens, the well-known railway engineer and former chief engineer of the Panama Canal; George F. Swain, professor of civil engineering in the Graduate School of Applied Science of Harvard University, and William C. Loree, who retired from the position of general manager of the Baltimore & Ohio Southwestern R.R. about a year ago. The committee states that these men were selected after consideration of about thirty names of engineers and railroad experts.

Messrs. Stevens, Swain and Loree have submitted a statement of their understanding of the work to be done, in which they say:

> We understand the problem is the study of the terminal facilities of New York City and the formulation of some plan which will correlate, simplify and facilitate the methods of collection, storage and distribution of freight in New York City. This problem involves the study of the various railroad and steamship terminals, their relation to business centers, the method of carrying freight through the streets, the interchange of freight between railroad and steamship lines—in general, the entire terminal facilities of the city.

They also submitted a schedule of the cost of organization of the proposed commission, which includes annual salaries of the three commissioners at $15,000 each and a secretary, a field engineer, a transportation engineer, a designing engineer and chief draftsman, and a real-estate expert, each at $5000. Other expenses for engineers, clerks and offices would bring the annual expenditure up to about $125,000 per year. The committee says that the work should take at least two years.

It is understood that the Board of Estimate and Apportionment will approve this scheme on Aug. 26, and that the commission, as suggested, will soon go into effect.

Death of Mendes Cohen

Mendes Cohen, past president of the American Society of Civil Engineers, and prominent in the early days of American railway engineering, died Aug. 13 at his home in Baltimore, Md., aged 84 years.

He was born May 4, 1831, soon after the Baltimore & Ohio R.R., one of the first railways in America, was put into operation. His father was a banker of Baltimore who helped to finance many of the early public works of this country.

The death of Mendes Cohen's father in 1847 resulted in the young man's starting out to earn a living at the age of 16 years. His first work was as apprentice machinist in the Baltimore locomotive works of the famous Ross Winans, builder of many early American locomotives. In 1851, at the age of 20 years, Mr. Cohen was appointed assistant engineer of the Baltimore & Ohio R.R. on work connected with the construction of the Broad Tree Tunnel.

On the completion of this work he was transferred to the motive-power department of the railway. Two important duties were assigned to him during this period—the adaptation of the wood-burning passenger locomotives to coal burning and the handling of traffic on the famous 10-per cent. temporary grade over the Kingwood Tunnel, a remarkable achievement in railway operation.

MENDES COHEN

At 24 years of age he became assistant superintendent of the Hudson River R.R., with which company he remained until 1861, when he succeeded Gen. George B. McClellan as operating head of the Ohio & Mississippi R.R., first being superintendent and later president and superintendent. Shortly after the end of the Civil War Mr. Cohen retired from this position and for a short time was connected with the Philadelphia & Reading Ry.

From 1868 to 1871 he was comptroller and assistant to the president of the Lehigh Coal & Navigation Co. In 1872 he was chosen president of the Pittsburgh & Connellsville R.R., which was subsequently consolidated with the Baltimore & Ohio R.R. system. For many years he was a prominent consulting engineer of Baltimore, and in 1892 was elected president of the American Society of Civil Engineers, of which he had been a member since 1867.

Irrigation in Southern Alberta

Extensive irrigation schemes affecting about 500,000 acres of new land in Southern Alberta are being developed by the irrigation branch of the Canadian Department of the Interior, under the direction of H. Peters, irrigation commissioner. The nucleus of the system now being planned is being opened up this season, covering 30,000 acres in the Taber district east of Lethbridge, which is under development by the Canadian Pacific Ry. The government engineers are now conducting a survey for the extension of this system for a considerable distance east of Taber. The second branch of the new system will include the area lying east of Stirling to Foremost, along the Lethbridge-Weyburn branch of the Canadian Pacific Ry. A third branch will cover the area east of Coutts along the international boundary. It is proposed to furnish the water for these branches of the system through three main arteries tapping the St. Mary's, Belly, Waterton and Milk rivers. As a considerable amount of the Milk River water will be diverted by an American irrigation project, the government engineers are planning to bring water from the Waterton and Belly rivers to make up for that to be thus diverted. An artery from the Milk River, a little to the West of Milk River town, will furnish the supply for the third branch. Survey parties are now in the field making an accurate survey of the course of the river.

Another scheme, the surveys for which have been already made by the government engineers, is known as the Old Man River diversion project, by which it is proposed to irrigate 100,000 acres of the lands to the north of Lethbridge. These various works will not be built and operated by the government, which simply proposes to undertake the necessary surveys so that they may be in readiness when construction is undertaken by local organizations. Under recent legislation adopted by the Alberta government the farmers are authorized to organize irrigation districts, bonding each district for the cost of the system, the farmers paying for the use of the water. This law will apply to all irrigation systems undertaken in the future. While the Old Man River project is likely to be executed in the near future, the construction of the other systems may be deferred for some time until the country to be served by them is more thickly settled.

Street-Railway Tracks in certain Ohio cities may be laid without the consent of abutting property owners, according to a decision of the Ohio Supreme Court on July 20. The decision affirms the right of a city to introduce into its charter a provision permitting street-railway tracks to be built by order of the City Council without obtaining the consent of a majority of the abutting property holders. In the city of Cleveland, certain wealthy property owners along Euclid Ave. between East 22nd and East 40th St. made an agreement years ago to give no consent for the laying of street-car tracks on the avenue unless all property owners joined therein. Under the decision now made by the court of last resort, the city authorities of any city in Ohio having a charter for self-government can rule as to the construction of street-railway extensions.

Disposal of Industrial Wastes—The headquarters for the investigation of methods for the disposal of industrial wastes, now being carried on by the United States Public Health Service, have been moved from Washington to Cincinnati, in order to coöperate with the Ohio River investigation in charge of Passed Asst. Surgeon W. H. Frost, U. S. Public Health Service. The industrial waste studies are under the supervision of Earle B. Phelps, Professor of Chemistry, Hygienic Laboratory, Washington, D. C., with H. B. Hommon in charge of the Cincinnati and field offices. The staff consists of Sanitary Chemist H. C. Colson, Jr., in charge of tests at tannery, Luray, Va.; Sanitary Bacteriologist Walter E. Brown, in charge of tests at strawboard plant, Noblesville, Ind.; Sanitary Engineer H. R. Crohurst; Sanitary Bacteriologists, W. v. D. Tiedeman and Emery J. Thierault, assisting in the studies of industrial wastes on the Ohio River watershed in the vicinity of Cincinnati.

The Kaw Valley Drainage Board will add 4 or 5 ft. to the height of its levees on the Kaw or Kansas River in Kansas City, Kan. This will bring the levee grade to the level of the floors of the highway bridges and to the top of the ties of the railway bridges. The freeboard room thus provided will accommodate a volume of water equal to the estimated entire flow of the river in the flood of June 30, 1903 (300,000 to 350,000 sec.-ft.). The Kansas City Southern Railroad Co. has agreed to raise the level of its bridge at the foot of Ohio Ave., which means a new and longer bridge, estimated to cost $135,000. The only other railroad bridge which is similarly obstructive is that of the Chicago Great Western (used also by the Missouri Pacific) at the mouth of the river. Efforts are being made to get this bridge raised also. The levees will be raised vertically in some places and on the present slope of 2 to 1 in others, widening portions of the top to 40 ft. The dirt will be obtained from the river channel by means of a dredge being built by the drainage board. Estimates of the yardage are now being made. S. H. McNeil is chief engineer and E. B. Murray, of Kansas City, is consulting engineer to the Kaw Valley Drainage Board, whose address is care of Osage & Pyle, Kansas City, Kan.

PERSONALS

Mr. G. E. Byars, recently City Engineer of Waco, Tex., has been appointed Superintendent of Buildings and Grounds of the Agricultural and Mechanical College of Texas at College Station.

Mr. O. P. Hand, former Advertising Manager of the Minneapolis Iron Store Co., of Minneapolis, has been appointed Director of Publicity of the Burd High Compression Ring Co., of Rockford, Ill.

Mr. J. Borge, formerly Chief Engineer of the National Incinerator Co., of New York City, and of Lewis & Kitchen, Chicago and Kansas City, has organized the Borge Incinerator Corporation, with offices in the Flatiron Building, New York City. He has been elected its President.

Mr. Gardner S. Williams, M. Am. Soc. C. E., Consulting Engineer, of Ann Arbor, Mich., has opened an office in Chicago, Ill., for the general practice of engineering specializing in the design, supervision and construction of hydro-electric developments, water-power and water-supply.

Mr. George M. Lehman, M. Am. Soc. C. E., Chief Engineer of the Lake Erie and Ohio River Canal Board, has been appointed by Gov. Martin G. Brumbaugh, of Pennsylvania, to represent the state at the Fifth National Drainage Congress, to be held in San Francisco Sept. 17 to 21, 1915.

Dr William S. Franklin, F. Am. Inst. E. E. resigned as Professor of Physics at Lehigh University, South Bethlehem, Penn. Dr. Franklin has been associated with Lehigh University since 1897, when he went there from Iowa State College as Professor of Physics and Electrical Engineering.

Mr. Morris Knowles, M. Am. Soc. C. E., Consulting Engineer, has acquired the engineering business formerly conducted by the late L. E. Chapin, of Pittsburgh, Penn., and Canton, Ohio. Mr. Knowles was associated with Mr. Chapin from 1902 to 1907. His offices are in the Oliver Building, Pittsburgh, Penn.

Mr. A. H. Whiteside has resigned as Sales Manager of the Goulds Manufacturing Co., Seneca Falls, N. Y. The sales department of the company is now divided into two parts, one directed by Mr. R. E. Hall, former Manager of the Boston office, and Mr. W. E. Dickey, former Manager of the New York office, both Vice-Presidents of the company.

Mr. H. H. Henderson, recently representing the Goulds Manufacturing Co., of Seneca Falls, N. Y., in northern West Virginia and southeastern Ohio has been appointed Manager of the company's Pittsburgh office in the Oliver Building. Mr. E. C. Wayne, of the main office at Seneca Falls, has been appointed Assistant Manager of the Pittsburgh office.

Mr. Lorenzo C. Dilks, Assoc. M. Am. Soc. C. E., recently General Manager of Sales of the Eastern Steel Co., New York City, has been elected President and General Manager of Milliken Brothers, Inc., New York City. Mr. Dilks has had many years' experience in the structural steel business with the Pencoyd Iron Works and the American Bridge Co.

Mr. J. H. Staats, M. Am. Soc. C. E., Vice-President and Treasurer of R. P. & J. H. Staats, Engineers and Contractors, has been elected Vice-President of the Snare & ' riest Co., Contracting Engineers, also of New York, which has acquired the equipment, plans, records and good-will of the contracting business of R. P. & J. H. Staats. Mr. R. P. Staats, M. Am. Soc. C. E., has retired from active business.

OBITUARY

William B. Dixey, of the Blaw Steel Construction Co., of New York City, died Aug. 11 at his home in Westfield, N. J.

Thomas Bliss Stillman, Chemical Engineer, former Professor of Engineering Chemistry ..t Stevens Institute of Technology, died recently at his home in Plainfield, N. J. He was born in 1852 and graduated from Rutgers College, New Jersey, in 1873. In 1883 he received the degree of Doctor of Philosophy from Stevens Institute of Technology, with which institution he was connected for many years, retiring in 1909 as Professor of Engineering Chemistry. He was at various times State Inspector of Oils of New Jersey, Examiner in Chemistry of the New York City Municipal Civil Service Commission, City Chemist of Jersey City and Bayonne, N. J., and Chemist of the Medical Milk Commission of Newark. He was a member of many scientific societies and the author of a well-known textbook on engineering chemistry.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
Aug. 16-18 and 25-28. Annual meeting in Los Angeles, Calif., Aug. 16-18; in San Francisco, Aug. 25-28. Secy., J. C. Olsen, Cooper Union, New York City.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.
Aug. 24-27. Annual convention in Cincinnati. Secy., Clarence R. George, Houston, Tex.

NEW ENGLAND WATER WORKS ASSOCIATION.
Sept. 7-9. Convention in New York City. Secy., Willard Kent, Narragansett Pier, R. I.

TRAVELING ENGINEERS' ASSOCIATION.
Sept. 7-10. Annual meeting in Chicago. Secy., W. O. Thompson, N. Y. C. R.R., East Buffalo, N. Y.

NORTHWESTERN ROAD CONGRESS
Oct. 4-7. At Cedar Rapids, Iowa. Secy., Jas. P. Keenan, Milwaukee, Wis.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.
Oct. 12-14. Annual convention at Dayton, Ohio. Secy., Charles Carroll Brown, 702 Wulsin Bldg., Indianapolis, Ind.

San Francisco Meetings

INSTITUTE OF RADIO ENGINEERS.
Sept. 13-18. Secy., David Sarnoff, 71 Broadway, New York.

PAN-AMERICAN ROAD CONGRESS.
Sept. 13-18. Secy., E. L. Powers, Road Builders Association, 150 Nassau St., New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 16-18. Secy., Charles Warren Hunt, 220 West 57th St., New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Sept. 16-18. Secy., Calvin W. Rice, 29 West 39th St., New York City.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Sept. 16-18. Secy., Bradley Stoughton, 29 West 39th St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Sept. 16-18. Secy., F. L. Hutchinson, 29 West 39th St., New York City.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
Sept. 16-18. Secy., J. J. Blackmore, 29 West 39th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY.
Sept. 16-18. Secy., J. W. Richards, Lehigh University, South Bethlehem, Penn.

NATIONAL DRAINAGE CONGRESS.
Sept. 17-21,

INTERNATIONAL IRRIGATION CONGRESS.
Sept. 20. Secy., Arthur Hooker, Sacramento, Calif.; until Aug. 1, New Stockton, Calif.

MINING AND METALLURGICAL SOCIETY OF AMERICA.
Sept. 20. Secy., F. F. Sharpless, 52 Broadway, New York City.

PACIFIC COAST ASSOCIATION OF PORT AUTHORITIES.
Sept. 20 and 21. Secy., Leo V. Merle, Ferry Bldg., San Francisco, Calif.

AMERICAN MINING CONGRESS.
Sept. 20-22. Secy., J. F. Calbreath, Washington, D. C.

INTERNATIONAL ENGINEERING CONGRESS.
Sept. 20-25. W. A. Cattell, Secy., Comm. of Management, Foxcroft Bldg., San Francisco.

INTERNATIONAL ASSOCIATION OF BRIDGE AND STRUCTURAL IRON WORKERS.
Sept. 20-30. Secy., Harry Jones, American Central Life Bldg., Indianapolis, Ind.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.
Sept. 21 and 22. Secy., F. M. White, Madison, Wis.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.
Sept. 23 and 24. Secy., W. H. Ross, 154 Nassau St., New York City.

AMERICAN MINE SAFETY ASSOCIATION.
Sept. 23 and 24. Secy., H. M. Wilson, Bureau of Mines, Pittsburgh, Penn.

AMERICAN ASSOCIATION OF REFRIGERATION.
Sept. 23 and 24. Secy., J. F. Nickerson, 431 South Dearborn St., Chicago, Ill.

ILLINOIS GAS ASSOCIATION.
Sept. 27. Adjourned meeting. Secy., H. H. Clark, 72 West Adams St., Chicago, Ill.

SAFETY CONFERENCE.
Sept. 27-30.

INTERNATIONAL GAS CONGRESS.
Sept. 27 to Oct. 1. Secy., George C. Ramsdell, 29 West 39th St., New York City.

AMERICAN GAS INSTITUTE.
Sept. 27 to Oct. 1. Secy., George C. Ramsdell, 29 West 39th St., New York City.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.
Oct. 4-9. Secy., E. B. Burritt, 8 West 40th St., New York City.

AMERICAN ELECTRIC RAILWAY MANUFACTURERS' ASSOCIATION.
Oct. 4-9. Secy., H. G. McConnaughy, 165 Broadway, New York City.

AMERICAN ELECTRIC RAILWAY ENGINEERING ASSOCIATION.
Oct. 4-9. Secy., E. B. Burritt, 8 West 40th St., New York City.

Cleveland Engineering Society—At the meeting of the executive board held on July 3, C. E. Drayer was appointed secretary of the Cleveland Engineering Society. Mr. Drayer is also secretary of the Committee on Engineering Coöperations of the society.

Texas Good Roads Association—Interesting sessions were held at the Aug. 5-6 convention of the Texas Good Roads Association, held at the Agricultural and Mechanical College of Texas. Two of the subjects under discussion were, "Are Special Road Laws Advisable" and "County Convict Labor." James P. Nash read a paper on "Economic Road Materials of Texas." Mrs. March Culmore explained why women favor good roads.

International Engineering Congress—A preliminary program of the International Engineering Congress to be held at San Francisco Sept. 20-25 has been prepared. The printed program will be issued at a later date. Discussions will be held on the following subjects on the days mentioned: General session, Sept. 20; Waterways, Sept. 20-23, mornings; Irrigation, Sept. 23-25, mornings; Municipal Engineering Sept. 21-24, mornings; Railway Engineering, Sept. 21-24, mornings; Materials of Engineering Construction, Sept. 21-23, afternoons; Mechanical Engineering, Sept. 21-24, afternoons; Electrical Engineering, Sept. 22-23, afternoons; Mechanical Engineering, Sept. 21-22, afternoons; Metallurgy, Sept. 21-24, afternoons; Naval Architecture and Marine Engineering, Sept. 21-24, afternoons; Miscellaneous, including Refrigeration, Agriculture, Education, Heating and Ventilating, Sept, 22-24.

Builders' Association of Kansas City—This association was recently formed for the purpose of "promoting and projecting the interests of its members; to maintain just and equitable treatment of their relations with each other and with their employees; to promote steadiness of employment in the building trade; to promote and facilitate the settlement of labor disputes; to prevent strikes, and to encourage the formation of an association of contractors." The officers are: President, James E. Taylor; first vice-president, J. Q. Smithers; second vice-president, E. L. Winn; treasurer, E. L. Marty; secretary, J. A. G. Badorf. On Aug. 5 the property and funds of the Master Builders' Exchange of Kansas City were transferred to the new association. The constitution of the Builders' Association provides for the following standing committees: Ways and means; finances; contracts; legal action and legislation; grievances; membership; promotion and publicity; trade relations. Provision is made for the recall of members and officers.

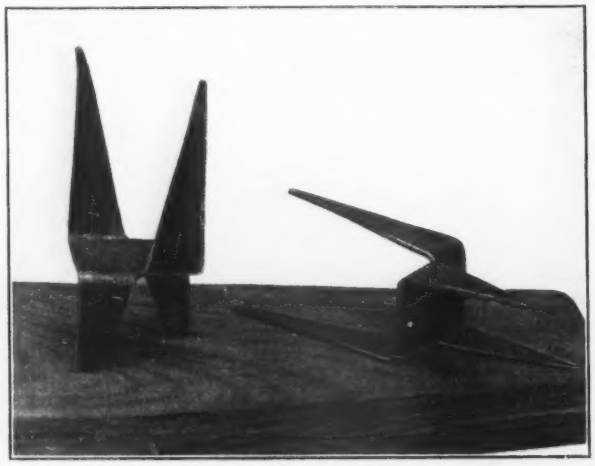
Concrete Road Building Conference—The organization of subcommittees for the Second National Conference on Concrete Road Building, to be held in Chicago, Feb. 15-18, 1916, has been completed. Seventeen committees have been named, each to investigate and submit a report upon a specific topic in

connection with the construction of concrete roads. The committees' subjects are as follows: (1) Drainage and preparation of subgrade; (2) economical widths of pavement and shoulders; (3) problems of design, thickness, crown and grade; (4) aggregates; (5) handling and hauling materials and water supply; (6) organization of concreting crew; (7) proportions of materials and consistency of concrete; (8) mixing and placing concrete; (9) reinforcing; (10) joint location and construction; (11) expansion and contraction; (12) finishing and curing; (13) construction of shoulders and curbs; (14) methods and cost of maintenance; (15) form of specifications; (16) cost of construction; (17) estimating and inspection problems. The Advisory Committee has again elected Dr. W. F. M. Goss, Dean of the College of Engineering of the University of Illinois, chairman and J. P. Beck, secretary.

Appliances and Materials

Chair for Reinforcing Bars

The chair shown in the accompanying view has been designed to support reinforcing bars in the forms during the placing of concrete. It differs somewhat from most devices for the purpose in that it is driven into the forms previous to placing the reinforcement, thereby insuring permanently the correct placing of the steel. Each chair is of heavy sheet steel cut and bent to develop two pairs of sharp prongs. The



REINFORCING-ROD CHAIR

lower pair are driven into the form floor and after the reinforcement has been placed the upper prongs are hammered down to grip the bars. The chairs are being marketed by the Shop-Fabricated Reinforcement Co., 1900 Euclid Ave., Cleveland, Ohio. They have been used recently on several Cleveland buildings. While it was thought by some that there might be difficulty in removing the forms, on account of the grip of the chair, no trouble of this sort has arisen.

* * *

Automatic Wheel-Flange Lubricator

For the lubrication of the wheel flanges of locomotives various automatic lubricators have been devised. One of the latest is the "Detroit Automatic," made by the Detroit Lubricator Co., of Detroit, Mich. The machine consists of an oil tank mounted in any convenient place—usually under the running board, a feed valve, and a delivery nozzle close to the flange. A loose ball in the feeder by impact momentarily opens the control valve. The lift and flow is controlled by spring tension. On switching engines the lubricator body is placed parallel to the boiler, so that shocks of stopping and coupling operate the valve. On road engines the lubricator is at right angles to the boiler and the ball is thrown by rolling on curves, etc. The device can be installed for one or more wheels.

* * *

Contractors' Geared Locomotive

While the Shay geared locomotive in various sizes (up to about 190 tons, noted in "Engineering News," Nov. 26, 1914) has been employed extensively in railway service, its application to construction lines is comparatively new. It has been used, however, on several large contracts for gravel and concrete roads. The engines thus employed are mainly of 13 and 18 tons' weight, the former being used generally for tracks of 24-in. gage. The accompanying illustration shows a 13-ton unit built by the Lima Locomotive Corporation, of Lima, Ohio, for H. W. Reed & Sons, of Mishawaka, Ind.

This type of geared locomotive has vertical cylinders at one side of the firebox, driving a crank axle parallel with the track. The engine is mounted on a pair of four-wheel trucks, and each wheel on the driving side of the engine has a

CONTRACTORS' GEARED LOCOMOTIVE

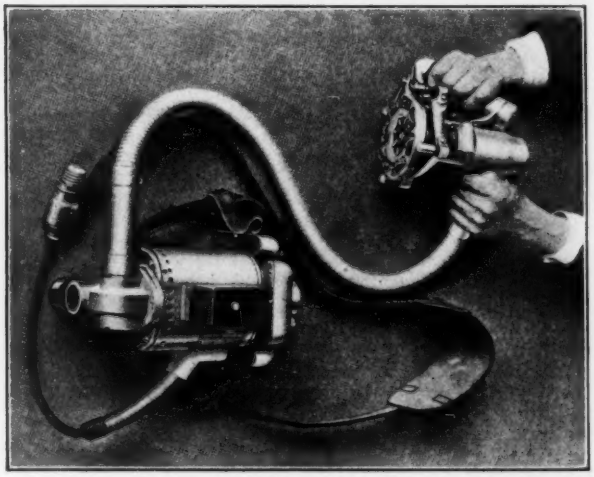
bevel gear bolted to its face. In the truck frame is carried a short shaft with bevel pinions engaging these gears. The truck shafts are connected to the crank axle by intermediate shafts having flexible couplings to allow for the swiveling of the trucks and for vertical irregularities of the track. The 13-ton engine has two 6x10-in. cylinders and 22-in. wheels. The truck wheel base is 4 ft. and the total wheelbase 18 ft. 10 in. The frame which supports the boiler and cylinders supports also the rear bunker, which holds ¾ ton of coal and 400 gal. of water. The maximum tractive effort is 6050 lb.

* * *

Concrete Surfacing Machine

A portable electric-driven tool for removing form marks, pits and irregularities from concrete walls, floors and ceilings has been devised by J. O. Berg and is being made by the Elevator Supply & Repair Co., Willow Ave. and 15th St., Hoboken, N. J. The machine is adapted also to remove metal scale, old paint, etc.

It comprises a small electric motor carried by the operator and a disk tool with 16 hardened-steel rotary chipping wheels



CONCRETE SURFACING MACHINE

driven by a flexible shaft. The entire outfit weighs 30 lb.; the tool alone weighs 9 lb. The motor is for use on both alternating- and direct-current lines of either 110 or 220 volts as desired. The machine is claimed to prepare 100 sq.ft. of wall per hour ready for float finish; 70 sq.ft. per hr. can be cut down to even color, and the aggregate exposed at the rate of 60 sq.ft. per hr. A cost reduction by machine-work of 50 to 75 per cent. below hand-work cost is reported.